99231700

OPERATION AND MAINTENANCE MANUAL

SC400 AUTOMATIC ANTENNA COUPLER

3855-703-0013

SEPTEMBER, 1978

SOUTHCOM INTERNATIONAL, INC.
A Subsidiary of Conic Corporation, A Loral Company

OPERATION AND MAINTENANCE MANUAL

SC400
AUTOMATIC
ANTENNA
COUPLER

SOUTHCOM INTERNATIONAL, INC.

A subsidiary of Conic Corp., A Loral Co.
2210 Meyers Ave., P.O. Box 2336
Escondido, California 92025, U.S.A.
Telephone (714) 746-1141
Cable: SOUTHCOM Telex: 695-400

Publication 99231700 Rev. 0

Printed in U.S.A.

9/78

TABLE OF CONTENTS

SECTION I. INTRODUCTION

1.1	Scope	1
1.2	Purpose	1
1.3	Physical Description	1
1.3.1	Size	1
1.3.2	Weight	1
1.3.3	Connections	1
1.4	Electrical Description	1
1.4.1	Specifications	1
1.4.2	Functional Description	1
1.5	Items Supplied	3
1.6	Optional Equipment	3

SECTION II. INSTALLATION

2.1	General	5
2.2	Unpacking and Inspection	5
2.3	Power Requirements	5
2.4	Mounting	5
2.5	Installations	5
2.5.1	Fixed Station	5
2.5.2	Jeep	5
2.6	Antenna Configurations	5
2.6.1	Whip Antenna	5
2.6.2	Long Wire Antenna	6
2.6.3	Resonant Antenna	6
2.7	Grounding	6
2.7.1	Antenna Grounding	8
2.8	Initial Adjustments	8
2.9	Interface Cables	8
2.9.1	Cable Identification	8
2.9.2	SC400/SC106 Interfacing	8
2.9.3	Coaxial Cable Fabrication	8
2.9.4	Control Cable Fabrication	8

SECTION III. OPERATION

3.1	General	13
3.2	Operation	13

SECTION IV. THEORY OF OPERATION

4.1	Block Diagram Description	15
4.2	Interface Wiring Diagram	15
4.3	System Operation	15
4.3.1	Tuning Characteristics	15
4.3.2	RF Tune Power	15
4.3.3	Coupler Bypass	18
4.4	Discriminator Assembly	18
4.4.1	Phase Discriminator	18

TABLE OF CONTENTS (CONT.)

4.4.2	Resistance Discriminator	20
4.4.3	Power Detectors	20
4.5	Control Logic Assembly	21
4.5.1	Power Supply	21
4.5.2	Servo Control	21
4.5.2.1	Variable Inductor Control Servo	21
4.5.2.2	Variable Capacitor Control Servo	22
4.5.2.3	Ramp Generator	22
4.5.2.4	L1 Drive Assembly	23
4.5.2.5	C1 Drive Assembly	24
4.5.3	Control Logic Circuits	24
4.5.3.1	Rechannel Logic	24
4.5.3.2	Elements Home Logic	24
4.5.3.3	Sequence Mode Logic & Control	24
4.5.3.4	Servo Enable & Logic Control	27
4.5.3.5	L1 Disable & Control Logic	27
4.5.3.6	Tune Power Request & Control Logic	27
4.5.3.7	Key Enable & Disable Control Logic	28
4.5.3.8	Key Hold Logic & Control	28
4.5.3.9	Keyhold/Fault Indicator Logic & Control	29
4.5.3.10	Fault Logic & Control	29
4.5.3.11	25 Second Timer, Homing/Tuning Fault Control	30
4.5.3.12	RF Power Status	30
4.5.3.13	RF Present Logic & Control	32
4.5.3.14	L1-to-Max Forcing Logic & Control	32

SECTION V. MAINTENANCE

5.0	General	35
5.1	Periodic Maintenance	35
5.1.1	Inspection	35
5.1.2	Cleaning & Lubrication	35
5.1.2.1	Variable Inductor Lubrication	35
5.1.2.2	Variable Capacitor Lubrication	35
5.2	Troubleshooting	35
5.2.1	Standard Troubleshooting Procedure	37
5.2.2	Troubleshooting Using the SC365 Test Set	37
5.3	Disassembly/Reassembly Procedures	43
5.3.1	SC400 Disassembly/Reassembly	43
5.3.1.1	Main Chassis Removal	43
5.3.1.2	Discriminator Removal	43
5.3.1.3	Variable Inductor Removal	43
5.3.1.4	Variable Inductor Reassembly	43
5.3.1.5	Inductor Drive Assy Removal & Reassembly	46
5.3.1.6	Variable Inductor End Stop Sensing Switch Replacement	46
5.3.1.7	Variable Capacitor Removal	46
5.3.1.8	Variable Capacitor Reassembly	46
5.3.1.9	Variable Capacitor Drive Assy Removal	46
5.3.1.10	Variable Capacitor Drive Assy Reassembly	46
5.3.1.11	Variable Capacitor End Stop Sensing Switch Replacement	46
5.3.1.12	Filter PC Board Removal	48
5.3.1.13	Transistor Q1 Replacement	48
5.4	Adjustment	48

TABLE OF CONTENTS (CONT.)

5.4.1 Discriminator 48
5.4.2 Variable Inductor. 50
5.4.3 Variable Capacitor 51
5.4.4 Spark Gap 51
5.5 Discriminator Test Cable Fabrication 51

SECTION VI. SCHEMATIC DIAGRAMS, COMPONENT LOCATION DRAWINGS & PARTS LISTS

6.1 General 53
APPENDIX 77

TABLES

1-1 Unit Specification 2
2-1 SC400 Interface Cables 9
5-1 Troubleshooting Chart 39
6-1 Parts List, SC400 Antenna Coupler, 992202 53
6-2 Parts List, Final Assembly, 992326 53
6-3 Parts List, Control Logic Assembly, 992300 56
6-4 Parts List, Discriminator Assembly, 992301 62
6-5 Parts List, Resistance Detector Assembly, 992303 62
6-7 Parts List, Discriminator Chasshis Assembly, 992304 63
6-8 Parts List, Inductor Drive Assembly, 992315 66
6-10 parts List, Motor/Gear Assembly, 992322 67
6-11 Parts List, Capacitor Drive Assembly, 992306 67
6-12 Parts List, EMI Filter Assembly, 992307 70
6-13 Parts List, Variable Inductor Assembly, 992310 72
6-14 Parts List, Inductor End Plate Assembly, 992330 72
6-15 Parts List, Capacitor Mounting Assembly, 992311 73
6-16 Parts List, Main Chassis Assembly, 992313 73
6-17 Parts List, Wiring Harness Assembly, 992313 74
6-18 Parts List, Fixed Inductor Assembly, 992321 74
6-19 Parts List, Accessory Kit, 992309 75

ILLUSTRATIONS

1-1	SC400 Automatic Antenna Coupler	vi
1-2	SC400 Major Subassemblies	3
2-1	SC400 and SC706 Dimension Drawing	4
2-2	SC400 Fixed Station Installation	5
2-3	SC400 Jeep Installation	6
2-4	Whip Antenna Installation	7
2-5	Long Wire Antenna Installation	7
2-6	SC400/SC106 Interface Connections	8
2-7	Coaxial Cable Connector Fabrication	9
2-8	Control Cable Fabrication	10
3-1	Programing SC106 Frequency	13
4-1	SC400 Block Diagram	14
4-2	SC400 Wiring Diagram	16
4-3	Block Diagram — Sequence of Events	17
4-4	Coupler Tuning Example	18
4-5	Discriminator Schematic	19
4-6	Simplified Phase Discriminator Schematic	19
4-7	Simplified Resistance Discriminator Schematic	20
4-8	Power Supply Schematic	21
4-9	Servo Control Diagram	22
4-10	Ramp Oscillator	23
4-11	Antenna Coupler Functional Diagram	25
4-12	Rechannel Pulse Generation	26
4-13	Elements Home Logic	26
4-14	Sequence Mode Logic & Control	26
4-15	Servo Enable & Control Logic	27
4-16	L1 Disable & Control Logic	28
4-17	Tune Power Request & Control Logic	28
4-18	Key Enable & Disable	29
4-19	Key Hold Logic & Control	29
4-20	Keyhold/Fault Indicator	30
4-21	Fault Logic	30
4-22	Timer, Fault Control	31
4-23	RF Power Status	31
4-24	RF Present Logic & Control	32
4-25	L1 to Max Forcing Logic & Control	33

ILLUSTRATIONS (CONT.)

5-1 SC400 Major Subassemblies 34
5-2 Variable Inductor Lubrication 36
5-3 Variable Capacitor Lubrication 36
5-4 Control Function Levels 37
5-5 Control Logic Funtion Locations 38
5-6 CD4001 39
5-7 CD4002 40
5-8 CD4011 40
5-9 CD4012 41
5-10 CA747 Dual Operational Amplifier 41
5-11 SC365 Test Set 42
5-12 Use of SC365 with SC400 42
5-13 Discriminator Assembly 44
5-14 Variable Inductor Drive Assembly 45
5-15 Variable Capacitor Drive Assembly 47
5-16 Transistor Q1 Assembly 48
5-17 Discriminator Alignment 49
5-18 Spark Gap Assembly 52

6-1 SC400 Generation Breakdown 54
6-2 Component Locations, Control Logic PC Board Assembly, A1 59
6-3 Schematic Diagram, Control Logic 60,61
6-4 Component Locations, Resistance Detector PC Board Assembly, A2A1 64
6-5 Component Locations, Phase Detector PC Board Assembly, A2A2 64
6-6 Component Locations, Discriminator Chassis Assembly, A2, A3 64
6-7 Schematic Diagram, Discriminator 65
6-8 Component Locations, Inductor Drive Assembly 68
6-9 Component Locations, Capacitor Drive Assembly 68
6-10 Schematic Diagram, Inductor Drive & Capacitor Drive 69
6-11 Component Locations, EMI Filter PC Board Assembly 70
6-12 Schematic Diagram, EMI Filter 71

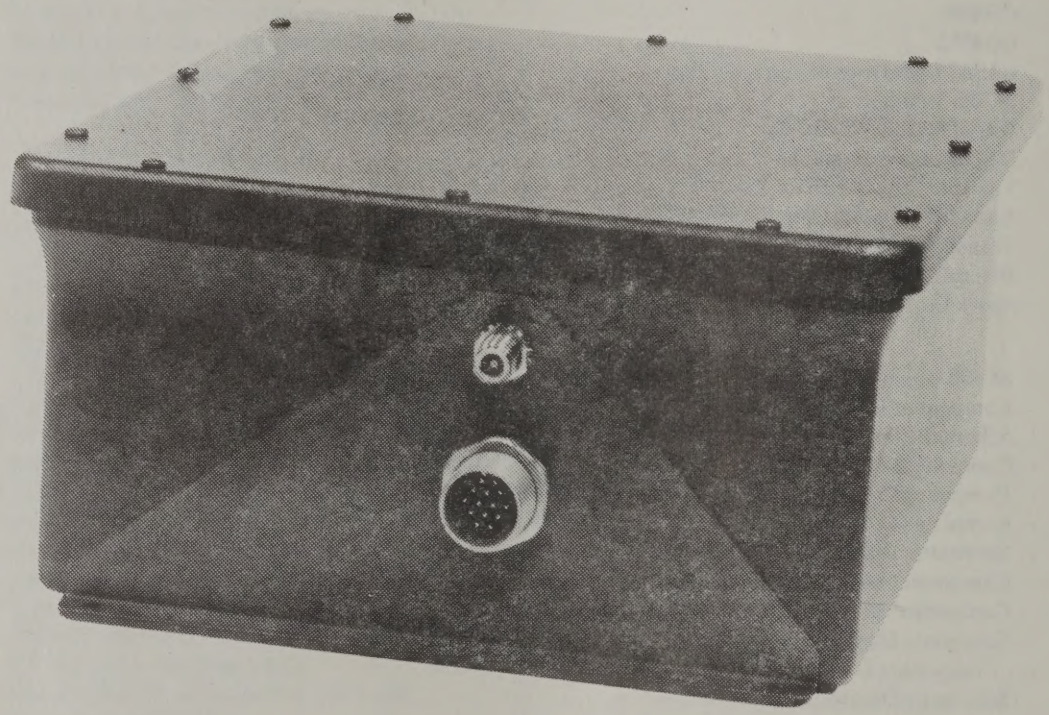


FIGURE 1-1. SC400 Automatic Antenna Coupler.

SECTION I
INTRODUCTION

1.1 SCOPE

This manual provides information for the installation, operation and maintenance of the SC400 Automatic Antenna Coupler. The information is organized into six sections as follows:

- **Section I:** Unit Description, Specifications, Configuration and Options
- **Section II:** Installation, Set-up and Initial Adjustments
- **Section III:** System Operation
- **Section IV:** Theory of Operation
- **Section V:** Maintenance Information and Procedures
- **Section VI:** Schematic Diagrams, Component Location Drawings and Parts Lists
- **Appendix:** Schematic Symbols and Abbreviations

1.2 PURPOSE

The SC400 is an Automatic Antenna Coupler designed for direct interface with Southcom's SC106 or AN/URC-96 Transceiver (hereafter referred to as the SC106). It automatically matches the output of the SC106 to a variety of whip and long wire antennas over the frequency range of 2 to 30 MHz. All operation, including network tuning and monitoring, is fully automatic. Tuning time is typically seven to eight seconds.

The SC400 is designed for continuous operation under the most severe environmental conditions. It is intended for vehicular, transportable, shipboard and fixed station applications. Automatic sensing circuitry protects the SC400 from defective antennas or any internal malfunctions.

The SC400 provides tactical security by permitting remote location of the antenna up to 250 feet from the associated radio receiver or transmitter. Since a radiating antenna is a potential target under combat conditions, the radio set and operator can be protected at a safe distance from the antenna.

1.3 PHYSICAL DESCRIPTION

The SC400 is contained in a standard olive drab case which is rugged, lightweight and completely waterproof. A photograph of the SC400 is shown in Figure 1-1.

1.3.1 Size

- Depth 15 1/4 inches (38.7 cm)
- Width 13 3/8 inches (34.0 cm)
- Height 6 1/2 inches (16.5 cm)

1.3.2 Weight

The maximum weight of the SC400 is 25 lbs. (11.34 kg).

1.3.3 Connections

Connections to the SC400 are as follows:

- Control Connector: #10-74720-27P (Southcom P/N 610058)
- RF Input Connector: Type N, Female, UG556 B/U (Southcom P/N 620049)
- Antenna connector: 5/16 –18 X 1 1/2 Bolt (Southcom P/N 810929)
- Ground Connector: 5/16 – 18 × 1 1/2 Bolt (Southcom P/N 810928)

1.4 ELECTRICAL DESCRIPTION

1.4.1 Specifications

Table 1-1 provides a list of specifications and interface control lines for the SC400.

1.4.2 Functional Description

Tuning of the antenna coupler is fully automatic. Upon receipt of a rechannel pulse from the SC106 or upon an initial primary power-on condition, the antenna coupler tuning elements proceed to the "home" positions. During this portion of the cycle, the transmitter is inhibited from transmitting. Also during this portion of the cycle, after the tuning elements have reached the home positions, the tuning elements are bypassed. If, at any time after receiving a rechannel pulse, the antenna coupler receives a momentary Key (Gnd) signal from the SC106, the antenna coupler locks up the keyline keeping it grounded and producing a constant signal on the Keyhold/Fault indication line which illuminates the TUNE light in the SC106.

After the tuning elements have reached the "Homed" position, the transmit inhibit signal is released. After receipt of a Key (Gnd), the antenna coupler disables the bypass function and enables the tune power circuits of the SC106. When RF tune power is received, the antenna coupler automatically tunes the antenna to a VSWR of 1.5:1 or less within 15 seconds, maximum (typical time is 8 seconds).

When tuning is completed, the antenna coupler releases the Key (Gnd) line and disables the signal on the Keyhold/Fault indication line. Normal transmissions from the transmitter are then allowed and VSWR protection circuitry is enabled. In the event of high reflected power, the transmitter is inhibited from transmitting and an intermittent signal on the Keyhold/Fault indication line

TABLE 1-1. Unit Specification.

Frequency Range and Tuning Capability	(2 to 30 MHz - 15 to 35 ft. (4.57 to 10.67m) whips, 75 to 150 ft. (22.86 to 45.72m) long wires, doublets, (2.5 to 30 MHz - 9 ft. (2.74m) whip).
Rated RF Input Power	Up to 150 watts PEP and average
Tuning Mode	Fully Automatic
Tuning Accuracy	1.5:1 VSWR or less referenced to 50 ohms
RF Efficiency	Typically 50 to 90% depending on antenna type and frequency
Tuning or Homing Time	Typically 7 to 8 seconds, 15 seconds maximum
Features	VSWR overload fault; Automatic receive capability in untuned state; Tuning and Homing time excess fault
RF Antenna Voltage	Up to 7000 volts peak at 150 watts input
Primary Power Requirements	22 to 36 VDC at: 5 watts, receive (untuned) 3 watts, receive (tuned) 10 watts, keyed (tuned) 180 watts, tuning (short duration peak) 25 watts, tuning (average)
Tune Power Requirements	10 watts minimum forward power throughout the tuning cycle (20 watts with 250 ft. (76.2m) separation).
Remote Capability	Up to 250 ft. (76.2m) separation between transmitter and SC400
Operating Environment	Waterproof (sealed), designed for exposed installations
Weight	25 pounds (11.34 Kg), maximum
Size	15.25 x 13.38 x 6.50 inches (38.74 x 33.97 x 16.51 cm), excluding projections and flanges 16.50 x 13.38 x 6.50 inches (41.91 x 33.97 x 16.51 cm), including projections and flanges
Operating Temperature Range	-30° C to $+60^{\circ}$ C
Control Lines	Keyline: ground when system is keyed; SC400 holds key during tuning cycle Key Enable (GND): ground from SC400 enables transmitter Key Enable (+): B+ from SC400 enables transmitter Tune Power Request: ground places transmitter at tune power level; mutes audio Tune/Fault Indication: + 22 VDC indicated tuning; intermittent indicates fault Rechannel: 30 ms or greater pulse for 10, 1, .1 and .01 MHz transmitter frequency changes. Homes SC400, resets fault (if there was one) and enables the receive function until keyed.

is produced to cause the TUNE and READY lights in the SC106 to alternately blink on and off. Upon receipt of a rechannel pulse from the SC106, the intermittent tone is removed and the tuning elements proceed to the home positions to start a new sequence.

1.5 ITEMS SUPPLIED

The SC400 Automatic Antenna Coupler consists of the major subassemblies identified in Figure 1-2.

An accessory kit is provided with the basic unit. It consists of mounting hardware, a Long Wire Adapter, the Operating and Maintenance Manual, and mating connectors. A detailed description of the accessory kit is included in Section VI.

1.6 OPTIONAL EQUIPMENT

The SC365 is an optional test fixture used to simply testing and troubleshooting of the SC400.

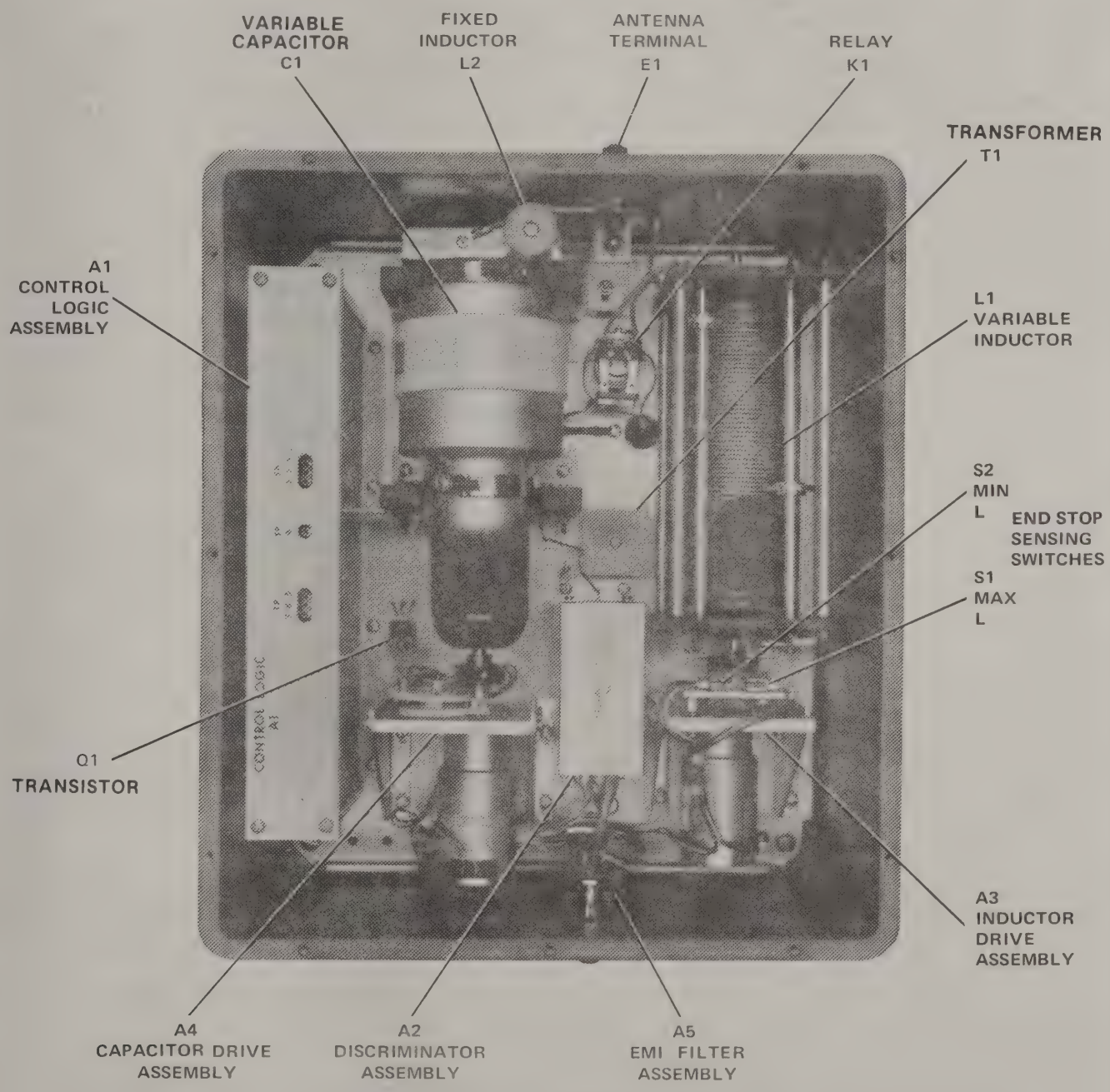


FIGURE 1-2. SC400 Major Subassemblies.

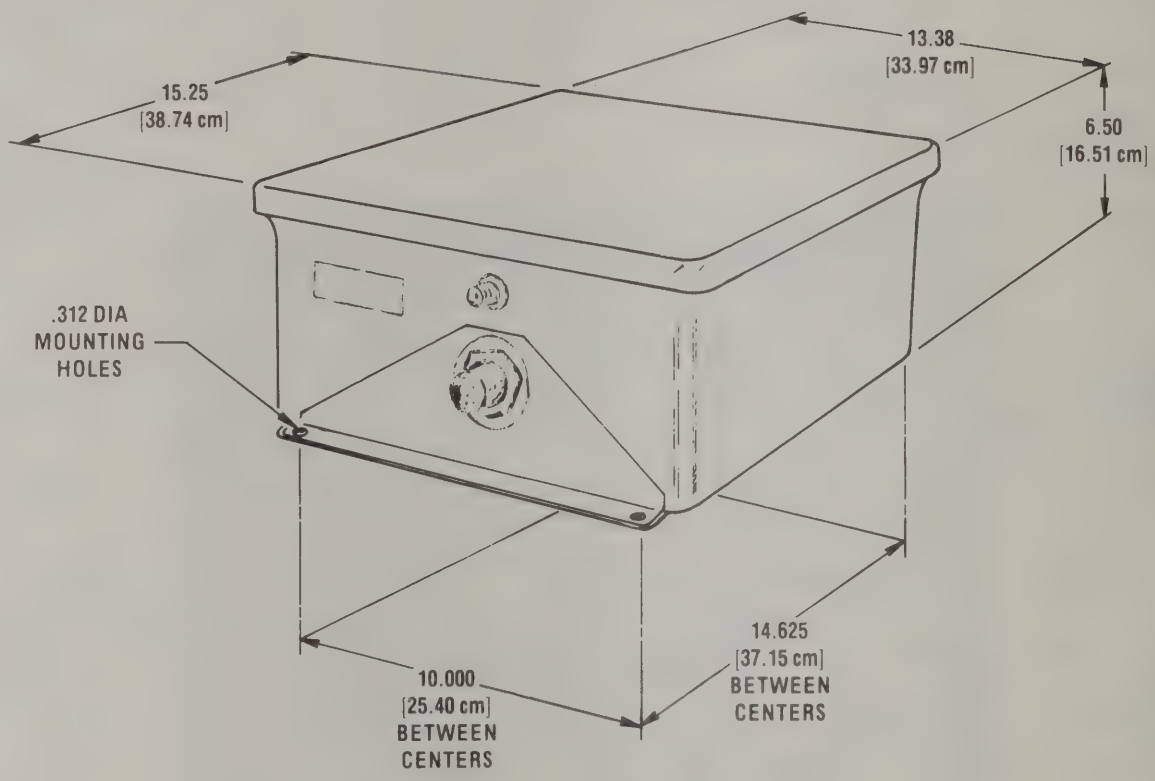


FIGURE 2-1. SC400 Mounting Dimensions.

SECTION II
INSTALLATION

2.1 GENERAL

This section describes the procedures that should be followed for installation and initial adjustment of the SC400.

2.2 UNPACKING AND INSPECTION

NOTE

All instructions in this manual should be read prior to installation.

Care should be taken when unpacking the SC400 to prevent damage to the external connectors.

After the unit is unpacked, a thorough visual inspection should be made. All connectors should be checked for damage and security. The unit should be carefully examined for any evidence of shipping damage.

2.3 POWER REQUIREMENTS

The SC400 requires a 22 to 36 volts DC primary power source. This voltage is normally provided from the SC106 Transceiver.

2.4 MOUNTING

The SC400 may be mounted directly to any convenient surface and oriented in any attitude. Figure 2-1 shows the mounting dimensions for the SC400.

2.5 INSTALLATIONS

2.5.1 Fixed Station

The SC400 is used with the SC106 in a fixed station installation to tune either whip, long-wire or resonant-type antennas. Separation between the SC400 and the transceiver should not exceed 250 feet (76.2 m). Figure 2-2 is a simplified block diagram of a typical configuration.

2.5.2 Jeep

Figure 2-3 depicts a typical jeep installation using the SC400, the SC106, the SC500 15 foot Whip Antenna, and the SC604 Remote Control Unit.

2.6 ANTENNA CONFIGURATIONS

2.6.1 Whip Antennas

Whip Antennas may be used for either fixed or vehicular installations. They have omni-directional radiation char-

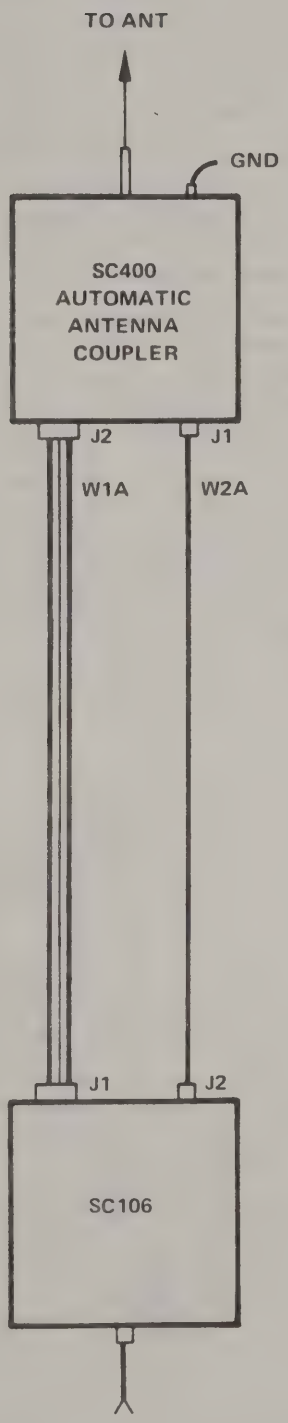


FIGURE 2-2. SC400 Fixed Station Installation.

acteristics and may be desirable for restricted space installations. Whip-type antennas SC500 or SC501, or their equivalents, are recommended for these installations. The longest antenna possible should be used to gain maximum efficiency.

Longer antennas permit greater effective radiation of transmitter power and avoids excessively high voltages at the coupler. FSK operation at low frequencies and into short antennas should also be avoided to prevent exceeding the power dissipating capability of the unit.

When antennas less than 1/8 wavelength are used, the antenna reactance present develops very high RF voltages with relatively small antenna currents. These small currents flowing in the radiation resistance yield low radiated power output.

The antenna post on the SC400 should be connected to the antenna base with a heavy, flexible, insulated cable, such as the insulated inner conductor from a length of RG-213/U. This cable should be kept as short as possible, not to exceed 2.5 feet (.762 m) in length.

Installation instructions are furnished with Southcom antennas. A typical fixed whip antenna installation is shown in Figure 2-4. Note that the ground system is an integral and very important part of any such installation. See paragraph 2.7 for detailed information on ground systems.

2.6.2 Long-Wire Antenna

For optimum operation between base stations, long-wire antennas are recommended.

When using 75 or 150 foot (22.86 or 45.72 m) long-wire-type antennas, it is advisable to mount the SC400 as close to the antenna base as possible. Cable type and installation precautions for this type antenna are basically the same as for whip-type antennas. Use the long-wire adapter supplied for this type installation. A typical long-wire-type antenna installation is shown in Figure 2-5.

2.6.3 Resonant Antenna Installations

Broad-band resonant antennas, such as log periodic antennas that cover the full range of the system, may be used effectively with the SC400 (using the long wire adapter). Resonant antennas constructed for operation at one frequency, or a narrow band of frequencies, should not be used because of their inherent frequency range limitations.

2.7 GROUNDING

Proper grounding of the SC400 cannot be overemphasized. Inadequate grounding will degrade operation of the system and cause buildup of RF voltage on the chassis. This condition could cause a malfunction and

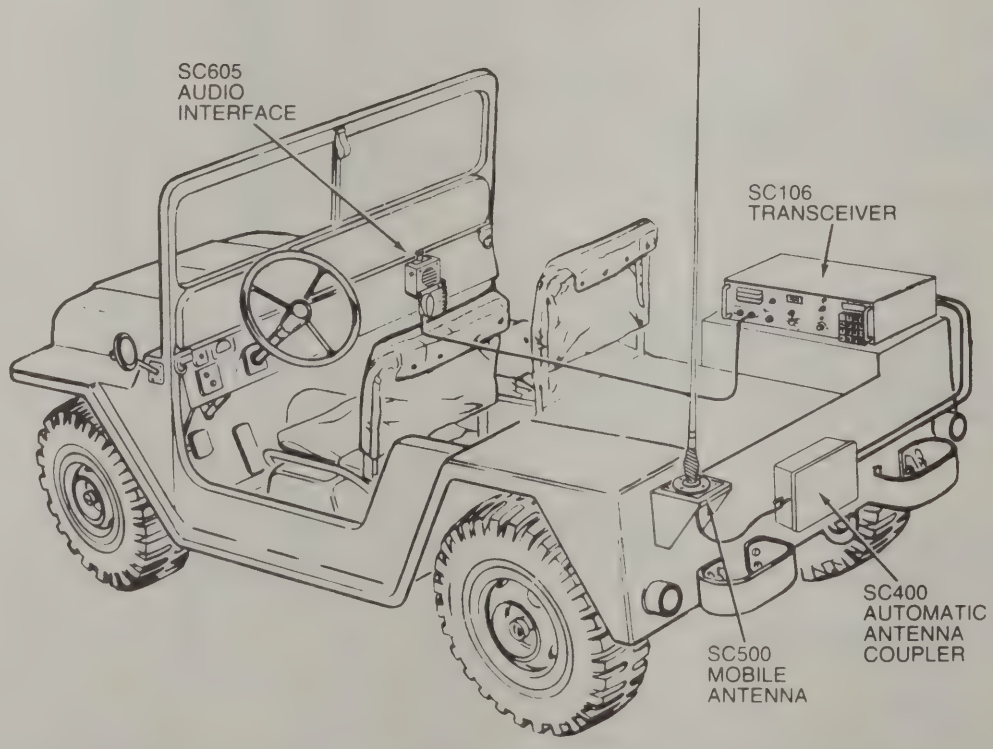


FIGURE 2-3. SC400 Jeep Installation.

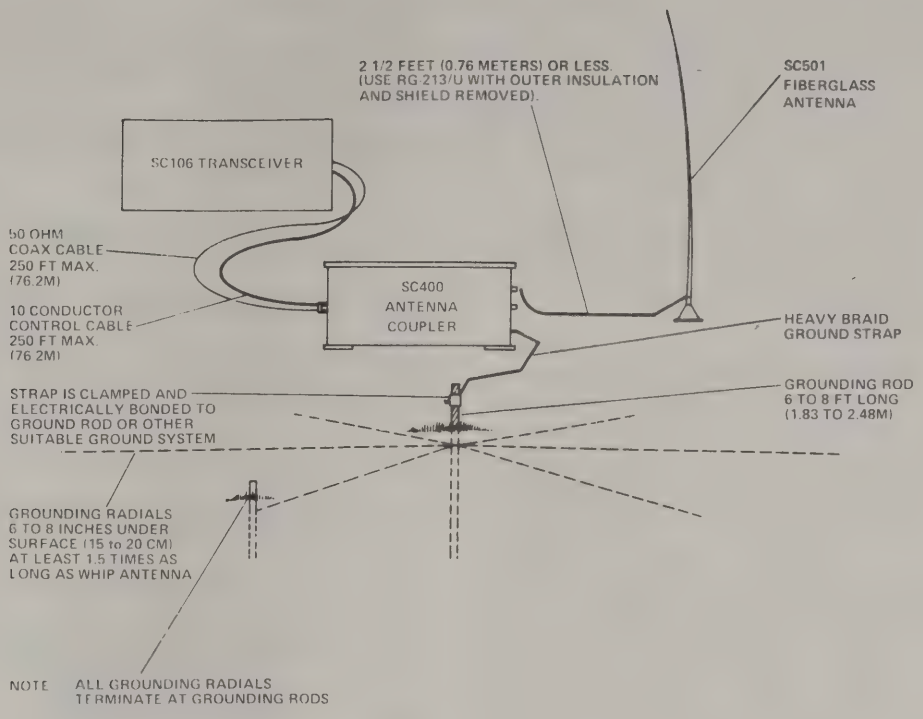


FIGURE 2-4. Whip Antenna Installation.

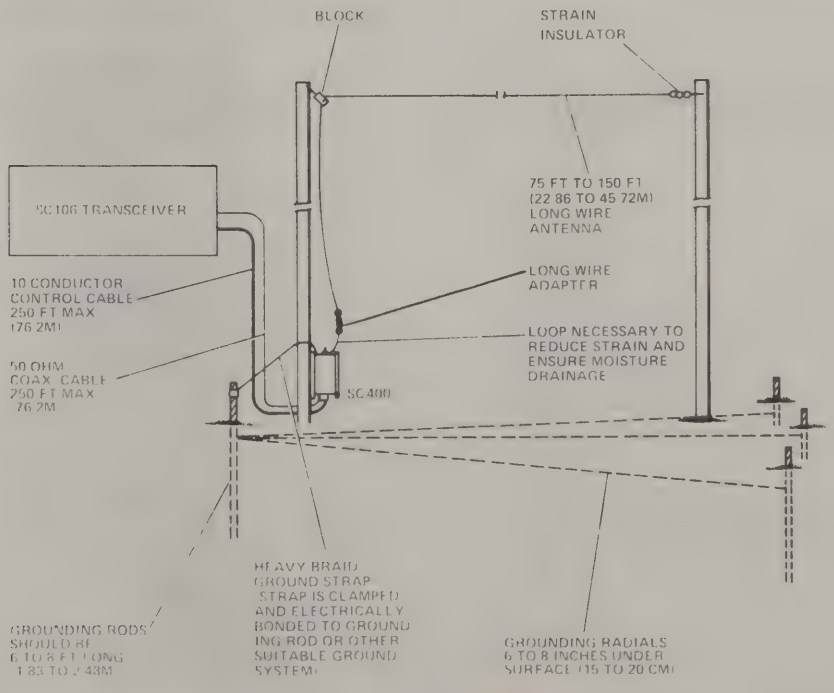


FIGURE 2-5. Long Wire Antenna Installation.

a possible serious personnel hazard. The ground strap should be constructed of heavy braid, be as short as possible, and be clamped and bonded to a ground stake at least 6 to 8 feet (1.83 to 2.44 m) long. A system of ground radials, slightly longer than the antenna, should be installed 6 to 8 inches underground per Figures 2-4 and 2-5.

The transceiver mount must have good ground connections. These should be made with heavy braid ground straps connected to a suitable ground system.

2.7.1 Antenna Grounding

The resistive component of the antenna impedance consists of two principle elements: the radiation resistance (that value of resistance which, if driven by the antenna current, would dissipate power equal to the power actually radiated by the antenna); and the ground resistance. Ground resistance is that value of resistance which, if driven by the antenna current, would dissipate power equal to the power lost in the ground system against which the antenna is driven. Ground resistance losses do not contribute to radiated power, but must be considered as part of the system. As a consequence, any reduction in ground resistance that can be effected by an efficient counterpoise system, and low resistance ground connections, make a direct contribution to performance.

2.8 INITIAL ADJUSTMENTS

Prior to energizing the SC400, check the primary power and ground connections to ensure proper configuration. The SC400 has been set-up, tested and completely adjusted prior to shipping. However, if adjustments are necessary, proceed as outlined in the maintenance section of this manual.

Energize the equipment and exercise by operating at all desired frequencies.

2.9 INTERFACE CABLES

2.9.1 Cable Identification

Table 2-1 gives a listing of all cables necessary for interfacing the SC400 with the SC106. Further interfacing information will be found in Figures 2-5 and 2-6.

2.9.2 SC400/SC106 Interfacing

Figure 2-6 shows all of the interfacing connections between the SC400 and the SC106.

2.9.3 Coaxial Cable Fabrication

Figure 2-7 gives a step-by-step breakdown for installing the UG-21C connector on the RG-213/U coaxial cable.

2.9.4 Control Cable Fabrication

Figure 2-8 gives a step-by-step breakdown for installing the MS3106F-20-27S connectors on control cable W1A. These procedures are applicable to all Multiconductor cables and connectors in this system. Included in this figure is information about waterproofing the connectors.

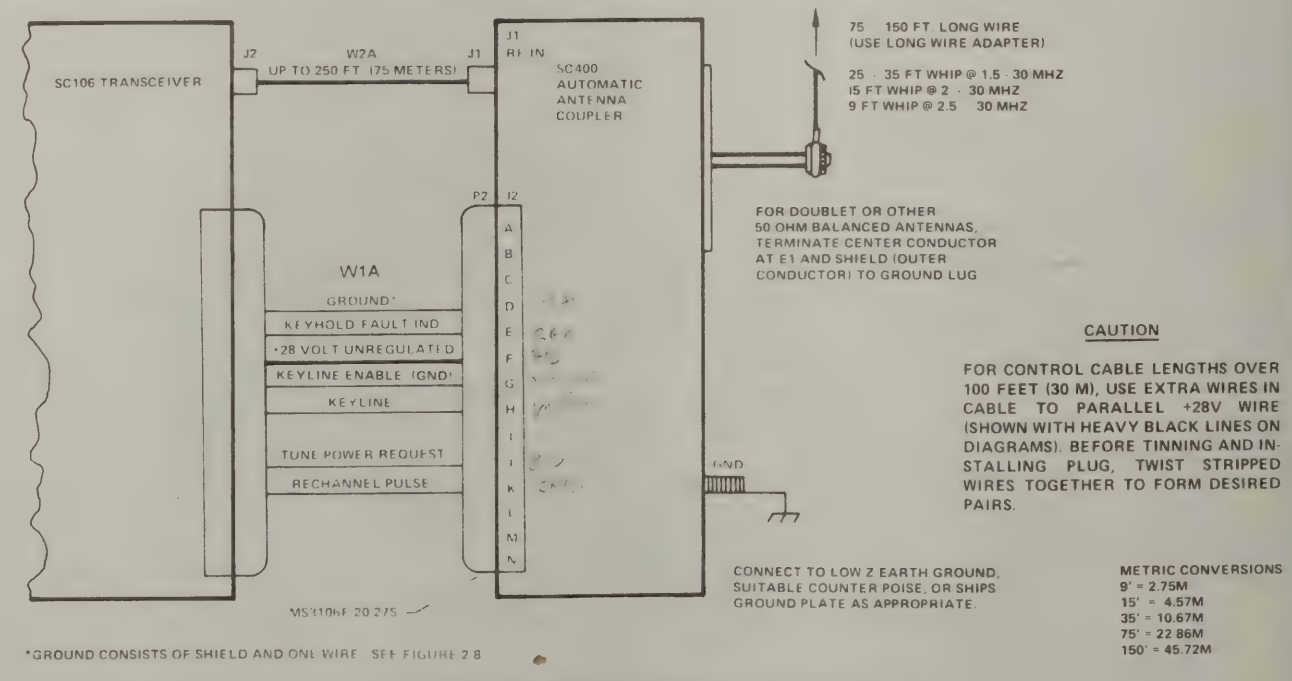


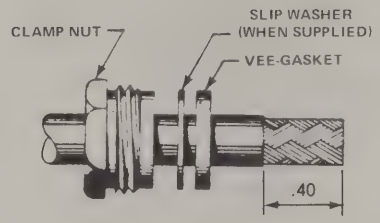
Figure 2-6 SC400/SC106 Interface Connections

TABLE 2-1. SC400 Interface Cables.

Cable No.	Use	Mating Connector	Cable Type	Mating Connector	Remarks
W1A	Control Multiconductor	MS3106F-20-27P	18AWG Wire (10 conductor) purchased separately	MS3106F-20-27S	Mating connectors supplied as part of SC400 and SC106
W2A	RF Coaxial	UG-21C	RG-213/U purchased separately	UG-21C	Mating connectors supplied as part of SC400 and SC106

STEP

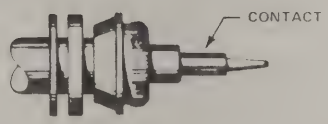
UG-21C Connector Assembly



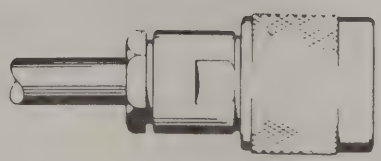
1. Cut cable end square, place clamp-nut, slip washer (when supplied), and gasket over jacket. Remove .40'' (1.02 cm) of vinyl jacket.

2. Place braid clamp over braid against jacket cut. Comb out copper braid as shown.

3. Fold braid back over braid clamp and trim as shown. Cut off dielectric .20 (.51 cm) from end. Tin center conductor.



4. Solder contact to center conductor. Avoid use of excessive heat. See that end of dielectric is clean. Contact must be flush against dielectric. Outside of contact must be free of solder.

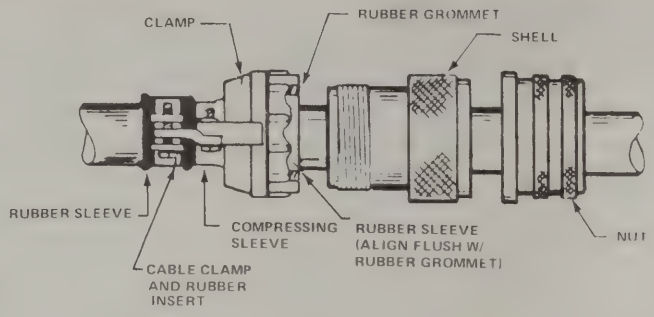


5. Thread assembly into connector and lock securely. Vee gasket must be split by braid clamp.

FIGURE 2-7. Coaxial Cable Connector Fabrication.

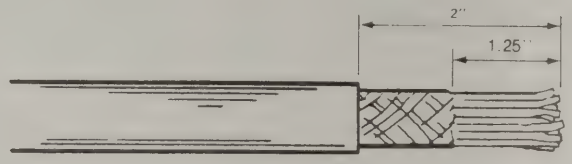
STEP

1



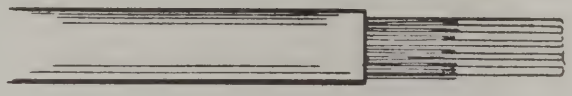
Install cable clamp and rubber insert, rubber sleeve clamp, compressing sleeve, rubber grommet, shell, and nut over cable. Assemble as shown. Leave cable clamp loose. Align rubber sleeve flush with rubber grommet inside clamp. Push assembly back out of the way to perform the steps shown below.

2



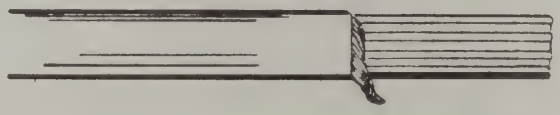
Remove 2" (5.08 cm) of vinyl jacket from cable as shown. Do not cut into shielding. Remove 1.25" (3.18 cm) of shielding as shown. Take care not to damage insulation on wires in cable bundle.

3



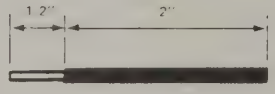
Carefully comb out shield wires as shown.

4



Make a part in the combed shield wires opposite the black wire in the cable. Pull the shield wires around both sides of the cable and twist together to make a pigtail as shown.

5



Remove ½" (1.27 cm) of insulation from a 2-½" (6.35 cm) length of No. 22 black stranded wire (supplied in SC400 Accessory Kit) and tin.

6

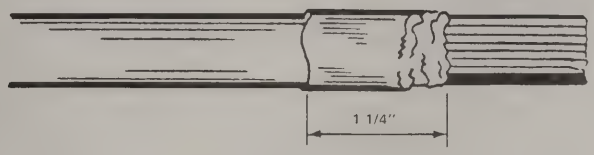
Twist the stripped end of black wire with the pigtail and solder. Cut ½" (1.27 cm) black shrink sleeving (supplied with the SC400 Accessory Kit) and install over soldered connection. Use a heat gun (an alternative is an open flame) to shrink sleeving exercising caution to avoid getting heat onto cable jacket.

7 → **13** See next page.

FIGURE 2-8. Control Cable Fabrication.

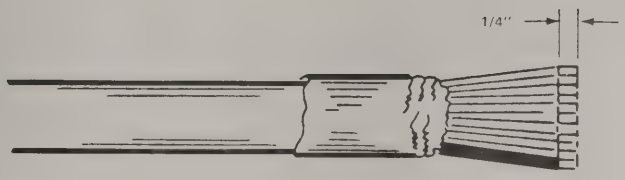
STEP

7



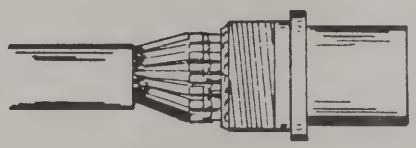
Install shrink sleeving (supplied in SC400 Accessory Kit) over cable as shown - apply heat and "shrink" in place. Use heat gun. If no heat gun is available, use open flame. Avoid getting heat on cable jacket. Rotate cable for an even shrinkage.

8



Remove ¼" (.635 cm) insulation from wires to be used.

9



Refer to Figure 2-6 for proper interface connections. Twist and tin stripped wires together to form pairs as shown for cable lengths over 100 feet (30 meters). Twist and tin remaining stripped wires. Cut sleeving supplied in connector kits in ½ inch (1.27 cm) lengths and slide over each wire. Keep wires parallel as they come out of the cable bundle to the connector pins. Ensure the black wire installed in step 6 and the black wire in the cable are lined up with and soldered to pin D. Solder wires to the solder cups. Slide sleeving over solder cups. Write down wire colors assigned to each pin number for reference when assembling the connector on the other end of the cable.

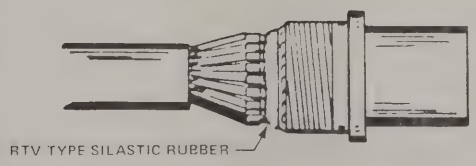
10

Repeat assembly and soldering procedures for the other end of the cable.

11

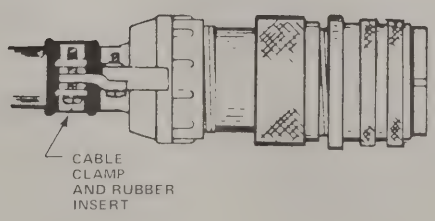
Check both ends of the cable for continuity, shorts between wires and shorts to the connector shell.

12



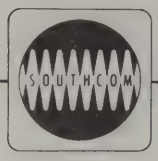
Apply RTV type silastic rubber (supplied in SC400 Accessory Kit) to a thickness of approximately 1/8 inch (.32 cm) Use small opening of nozzle to insure getting rubber between all solder cups. Use small, slender object such as a piece of wire or toothpick to insure a smooth, continuous waterseal.

13



Assemble the plug as shown. Assemble clamp as tightly as possible onto the shell to assure a watertight connection around the cable. Repeat watersealing and assembling of connector on other end of cable. After connector has been threaded on SC400 Coupler case connector J2, wrap both connectors with several layers of plastic electrical tape (supplied in SC400 Accessory Kit) as close to the SC400 Coupler case as possible. (For protection against corrosion of mating threads in wet or humid environments.)

FIGURE 2-8 Control Cable Fabrication continued


SOUTHCOM

SECTION III
OPERATION

3.1 GENERAL

The SC400 is designed to operate with the SC106 Transceiver; however, it may be used with other transceivers having compatible interface characteristics (as described in Table 1-1). This section covers the operation of the SC400 with the SC106.

3.2 OPERATION

The following procedures should be followed when operating the SC400 with the SC106 in any configuration.

a. Visually inspect the equipment condition; check for personnel hazards.
b. Visually inspect the overal system configuration and installation; check for proper cable connections and grounding procedures.
c. Select the operating mode of the SC106, i.e., LSB, USB, AME, CW or FSK.
d. Turn on power via the volume control of the SC106. Note that there are no operator controls on the SC400.
e. Program the frequency. Refer to Figure 3-1.

NOTE

All digits thru 100 Hz must be entered.

f. Momentarily key the SC106 to initiate tuning the SC400. The SC400 will hold the key condition until tuning is completed. The system is ready for use when the READY indicator on the SC106 lights.
g. To rechannel the SC400, make the desired frequency change and repeat Step f.

Simplex [Identical transmit and receive frequencies]

1. Press [R/T]
2. Enter frequency digits
3. Press [E]

e.g.: To program 15.1790 MHz, press the following keys in the sequence shown:

[R/T] [1] [5] [1] [7] [9] [0] [E]

15.1790 should be displayed

Half Duplex [Separate transmit and receive frequencies]

1. Press [R]
2. Enter receive frequency digits
3. Press [E]
4. Press [T]
5. Enter transmit frequency digits
6. Press [E]

e.g.: To program a receive frequency of 7.6281 MHz and a transmit frequency of 29.3216 MHz, press the following keys in the sequence shown:

[R] [7] [6] [2] [8] [1] [E]
[T] [2] [9] [3] [2] [1] [6] [E]

7.6281 should be displayed. T29.3216 should be displayed when the T key is depressed.

FIGURE 3-1. Programming SC106 Frequency.

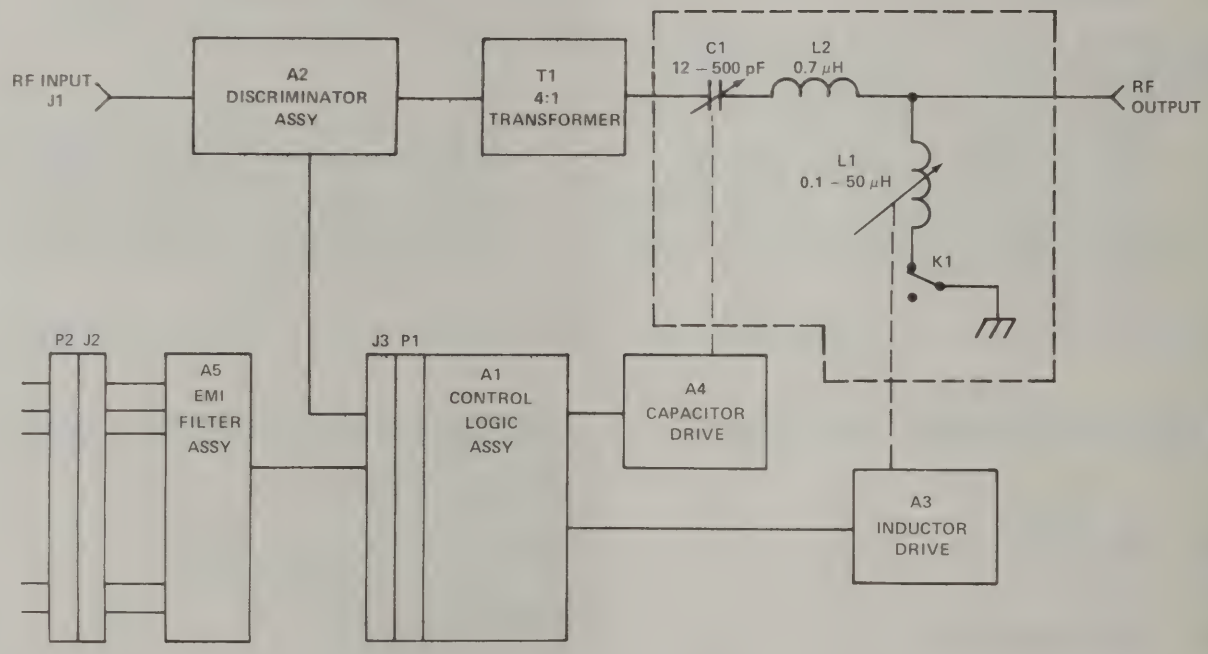


FIGURE 4-1. SC400 Block Diagram.

SECTION IV
THEORY OF OPERATION

4.1 BLOCK DIAGRAM DESCRIPTION

The SC400 Automatic Antenna Coupler matches the output of 100 — 150 watt transmitters to a wide variety of whip or long wire antennas. Since the SC400 is completely automatic, all network tuning, control and monitoring functions are self-contained. Figure 4-1 is a simplified block diagram of the SC400 showing the tuning elements and major control system assemblies.

The 100 — 150 RF input at J1 is routed directly to the A2 Discriminator Assembly. The discriminator incorporates three functional elements: (1) a forward and reflected power detector; (2) a phase detector; (3) and a resistance detector. All three discriminator functions have a characteristic impedance of 50 ohms.

The discriminator provides the sense information used for both tuning and monitoring. The phase detector output is an indication of the phase angle of the coupler input impedance (referenced to zero degrees), and is used to control the operation of the variable tuning capacitor (C1). The resistance detector output indicates the real part of the coupler input impedance (referenced to 50 ohms), and controls operation of the variable tuning inductor (L1). The forward power detector provides a voltage proportional to the amount of forward RF power into the coupler; it is used to indicate the presence of RF power for tuning and also as an analog representation of forward power for metering. The reflected power detector provides a voltage proportional to reflected RF power and is used to monitor tuning accuracy and also (in conjunction with the forward power detector) to indicate VSWR for comparison with predetermined tuning thresholds.

The SC400 is designed for use with transmitters that have a standard 50 ohm output impedance. There are advantages, however, in operating automatic antenna coupler systems at a characteristic impedance lower than 50 ohms. This system uses an R_O, or operating impedance, of 12.5 ohms. Transformer T1 has a turns ratio of 2:1, or an impedance ratio of 4:1, and thus serves to match the optimum 12.5 ohm antenna system to the standard 50 ohm transmitter output.

Vacuum variable capacitor C1 and variable inductor L1 are driven by separate servo systems such that the SC400 will automatically tune the antenna impedances. The Phase Detector output drives the C1 servo system, and the Resistance Detector drives the L1 servo system. The complete tuning network consists of C1, L1, and L2 (a fixed 0.7μH inductor). Relay K1 is used to remove L1 from the circuit to provide a bypass of the tuning network, if desired, for either "receive only" or half-duplex operation.

All of the interface and control information from both the associated transceiver and the discriminator assembly is routed to and processed by the A1 Control Logic Assembly. The circuitry in this module is used to monitor keyline, transmitter rechanneling, RF power level, and antenna load condition; and makes the appropriate sequence of responses required to provide automatic operation.

4.2 INTERFACE WIRING DIAGRAM

Figure 4-2 is a diagram depicting the internal wiring of the SC400. Assembly names, connector pins, and line descriptions are all clearly called out on this diagram.

4.3 SYSTEM OPERATION

Figure 4-3 shows the sequence of events in the SC400 from initial application of primary power through transmitter keying, the final step that indicates successful tuning of the coupler. The normal sequence of events is indicated by unbroken lines; incorrect responses or malfunctions are indicated by broken lines. At each stage of the sequence, references are made to related detailed circuit descriptions and illustrations contained in this section.

4.3.1 Tuning Characteristics

The SC400 has been designed to have the capability to tune short whip and long wire antennas over the frequency range of 2-30 MHz. Providing the system is properly installed and good grounding is provided, tuning capability is directly proportional to antenna impedance and operating frequency (for a given set of tuning element values). Figure 4-4 gives an illustration of how the SC400 tuning network operates to match a typical antenna impedance. A 15 foot whip antenna has a load impedance (depending on ground conditions) of 10-j1500 ohms at 2 MHz. In order to tune this antenna, the SC400 uses its variable inductor (L1) to shunt the antenna impedance in a circular fashion to $Z_B = 12.5 + jX_B$. The variable capacitor (C1) then resonates Z_B to $R_O = 12.5 + j0$. Transformer T1 then transforms R_O to $50 + j0$ ohms.

4.3.2 RF Tune Power

The SC400 needs a minimum of 10 watts of forward RF power at its input during the tune cycle for the discriminator circuits to function correctly. Therefore, the asso-

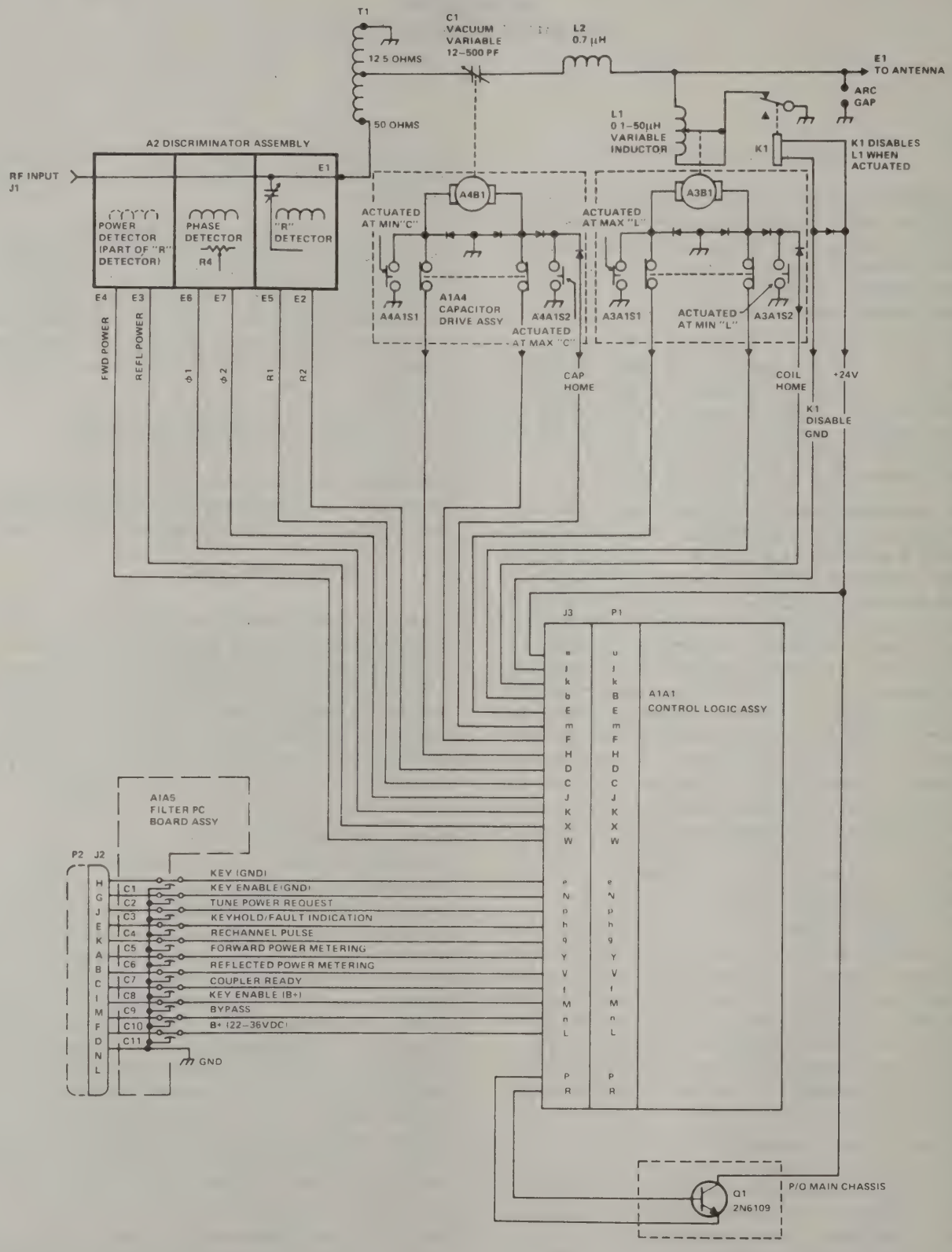


FIGURE 4-2. SC400 Wiring Diagram.

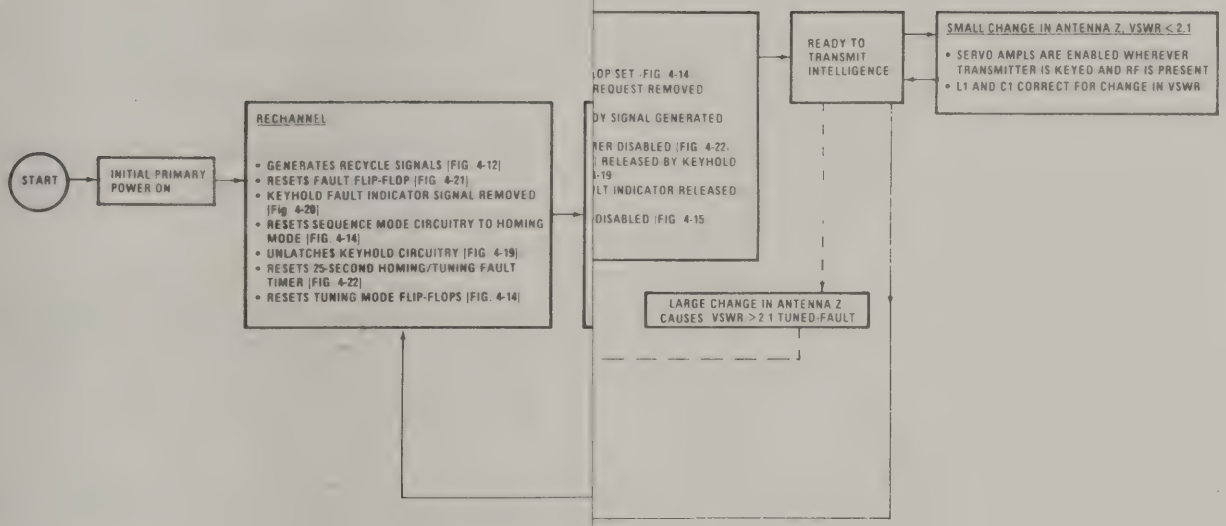


FIGURE 4-3. BLOCK DIAGRAM - SEQUENCE OF EVENTS.

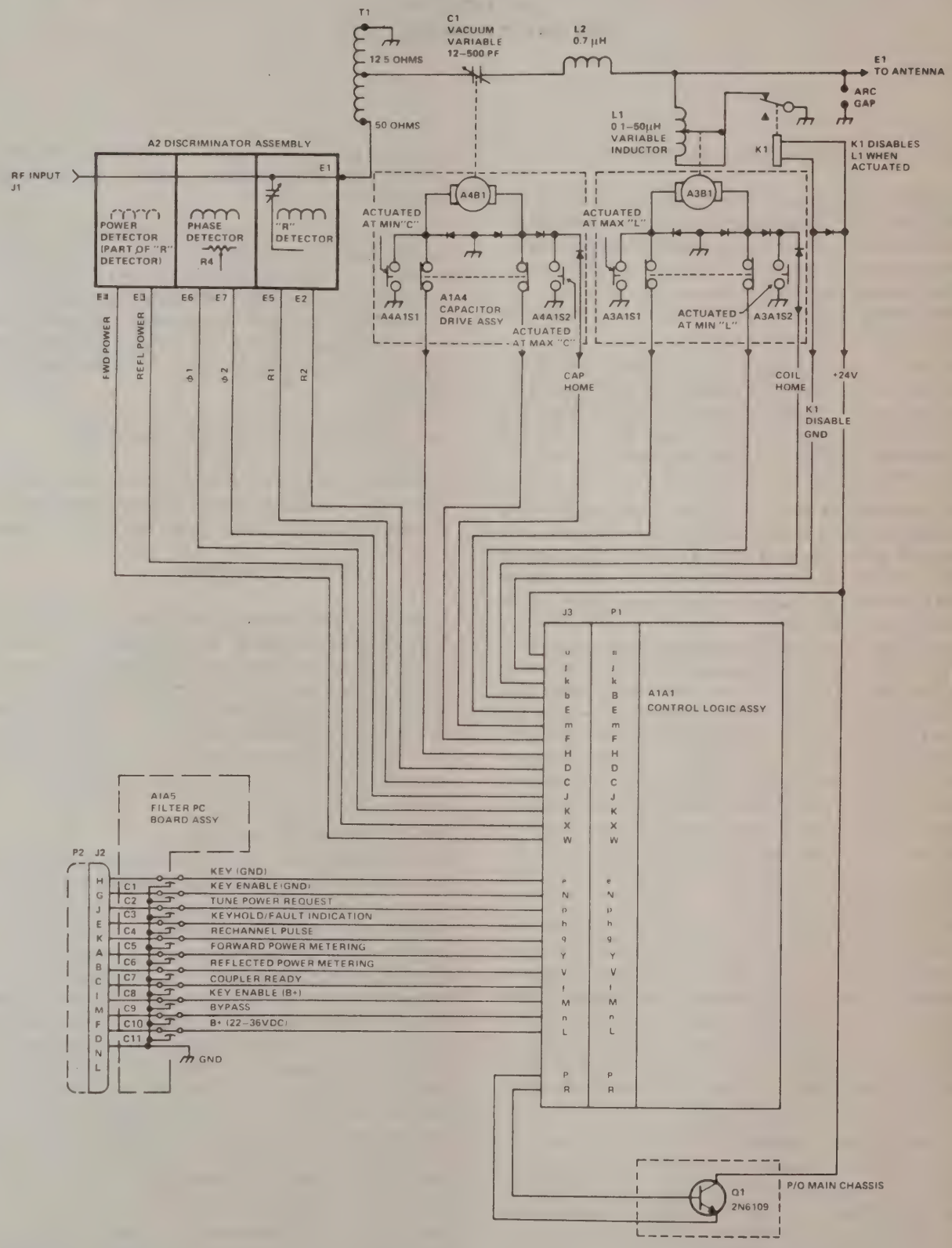


FIGURE 4-2. SC400 Wiring Diagram.

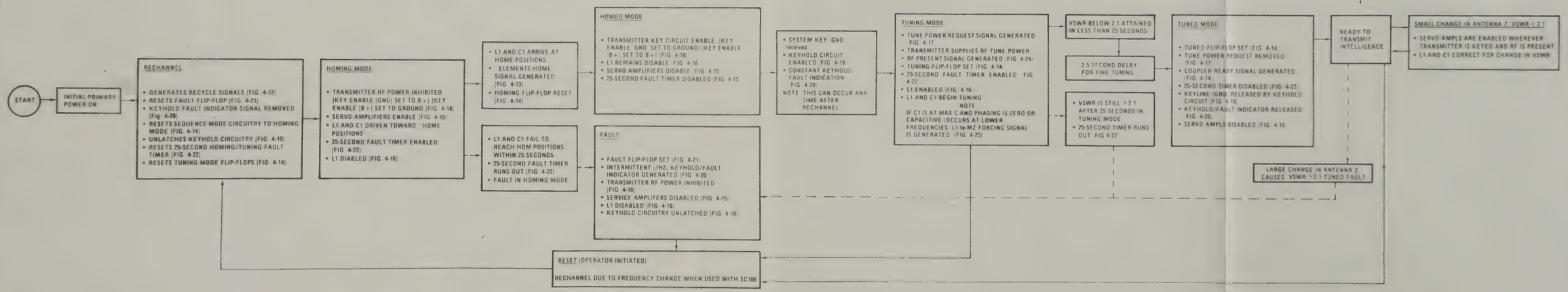

START
INITIAL PRIMARY POWER ON
RECHANNEL
• GENERATES RECYCLE SIGNALS (FIG 4-12)
• RESETS FAULT FLIP-FLOP (FIG 4-21)
• KEYHOLD FAULT INDICATOR SIGNAL REMOVED (Fig 4-20)
• RESETS SEQUENCE MODE CIRCUITRY TO HOMING MODE (FIG 4-14)
• UNLATCHES KEYHOLD CIRCUITRY (FIG 4-19)
• RESETS 25-SECOND HOMING/TUNING FAULT TIMER (FIG 4-22)
• RESETS TUNING MODE FLIP-FLOPS (FIG 4-14)
HOMING MODE
• TRANSMITTER RF POWER INHIBITED (KEY ENABLE (GND) SET TO B+) (KEY ENABLE (B+) SET TO GROUND (FIG 4-18)
• SERVO AMPLIFIERS ENABLE (FIG 4-15)
• L1 AND C1 DRIVEN TOWARD "HOME" POSITIONS
• 25-SECOND FAULT TIMER ENABLED (FIG 4-22)
• L1 DIABLED (FIG 4-16)
• L1 AND C1 ARRIVE AT HOME POSITIONS
• ELEMENTS HOME SIGNAL GENERATED (FIG 4-13)
• HOMING FLIP-FLOP RESET (FIG 4-14)
HOMED MODE
• TRANSMITTER KEY CIRCUIT ENABLE (KEY ENABLE GND SET TO GROUND) (KEY ENABLE B+) SET TO B+) (FIG 4-18)
• L1 REMAINS DISABLE (FIG 4-16
• SERVO AMPLIFIERS DISABLE (FIG 4-15
• 25-SECOND FAULT TIMER DISABLED (FIG 4-15
• L1 AND C1 FAIL TO REACH HOM POSITIONS WITHIN 25 SECONDS
• 25-SECOND FAULT TIMER RUNS OUT (FIG 4-22)
• FAULT IN HOMING MODE
FAULT
• FAULT FLIP-FLOP SET (FIG 4-21)
• INTERMITTENT (/HZ, KEYHOLD/FAULT INDICATOR GENERATED (FIG 4-20
• TRANSMITTER RF POWER INHIBITED (FIG 4-18)
• SERVICE AMPLIFERS DISABLED (FIG 4-15)
• L1 DISABLED (FIG 4-16)
• KEYHOLD CIRCUITRY UNLATCHED (FIG 4-19)
• SYSTEM KEY GND received
• KEYHOLD CIRCUIT ENABLED (FIG 4-19
• CONSTANT KEYHOLD/FAULT INDICATION FIG 4-20)
NOTE THIS CAN OCCUR ANY TIME AFTER RECHANNEL
TUNING MODE
• TUNE POWER REQUEST SIGNAL GENERATED FIG 4-17
• TRANSMITTER SUPPLIES RF TUNE POWER
• RF PRESENT SIGNAL GENERATED (FIG 4-24)
• TUNING FLIP-FLOP SET (FIG 4-14)
• 25-SECOND FAULT TIMER ENABLED FIG 4-22
• L1 ENABLED (FIG 4-16
• L1 AND C1 BEGIN TUNING
NOTE
IF C1 IS AT MAX C AND PHASING IS ZERO OR CAPACITIVE (OCCURS AT LOWER FREQUENCIES, L1-to-MZ FORCING SIGNAL IS GENERATED (FIG 4-25)
VSWR BELOW 2:1 ATTAINED IN LESS THAN 25 SECONDS
2.5 SECOND DELAY FOR FINE TUNING
• VSWR IS STILL > 2:1 AFTER 25 SECONDS IN TUNING MODE
• 25-SECOND TIMER RUNS OUT FIG 4-22
TUNED MODE
• TUNED FLIP-FLOP SET (FIG 4-14)
• TUNE POWER REQUEST REMOVED (FIG 4-17
• COUPLER READY SIGNAL GENERATED (FIG 4-14
• 25-SECOND TIMER DISABLED (FIG 4-22
• KEYLINE (GND RELEASED BY KEYHOLD CIRCUIT (FIG 4-19)
• KEYHOLD/FAULT INDICATOR RELEASED FIG 4-20)
• SERVO AMPLS DISABLED (FIG 4-15)
READY TO TRANSMIT INTELLIGENCE
SMALL CHANGE IN ANTENNA Z, VSWR < 2:1
• SERVO AMPLS ARE ENABLED WHEREVER TRANSMITTER IS KEYED AND RF IS PRESENT
• L1 AND C1 CORRECT FOR CHANGE IN VSWR
LARGE CHANGE IN ANTENNA Z CAUSES VSWR > 2:1 TUNED FAULT
RESET (OPERATOR INITIATED)
RECHANNEL DUE TO FREQUENCY CHANGE WHEN USED WITH SC106

FIGURE 4-3. BLOCK DIAGRAM - SEQUENCE OF EVENTS.

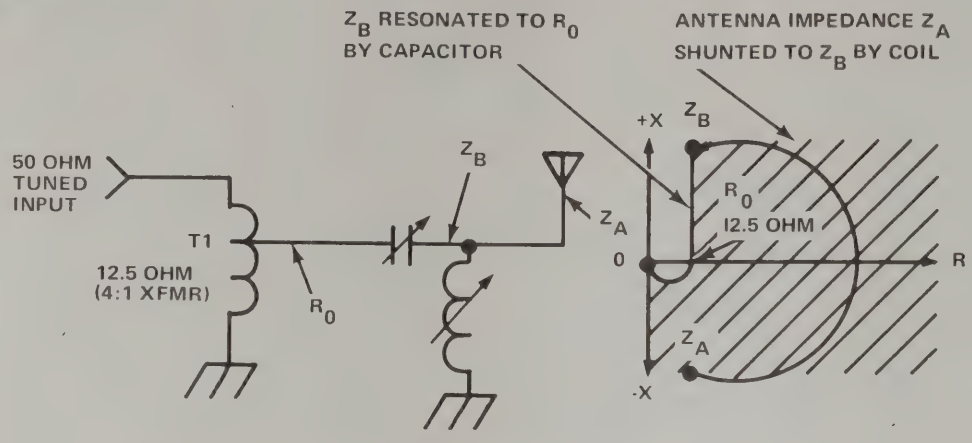


FIGURE 4-4. Coupler Tuning Example.

ciated transmitter (SC106) must provide this power to the coupler regardless of the separation between transmitter and coupler. This separation can be up to 250 feet and must be taken into consideration.

For example, at 30 MHz 250 feet of RG-213/U coaxial cable has about 3 dB insertion loss. This means that for 250 feet of separation between the transmitter and SC400, the transmitter should deliver a minimum of 20 watts of unmodulated carrier at its output to assure a proper tune at 30 MHz. Note that the maximum recommended separation is 250 feet. This recommended limitation is because of losses in the coaxial and control cables.

The SC106 uses its AM carrier as the RF signal provided to the coupler for tuning. This signal level is 25 watts minimum. Cable lengths longer than 250 feet may be used between the transmitter and SC400 as long as the additional attenuation (a function of frequency and cable size) is accounted for.

4.3.3 Coupler Bypass

A relay in the SC400 can be switched in to minimize network impedance to effectively "bypass" the coupler tuning network when desired. Under normal simplex operation, the relay is not activated and the tuning network is always in the circuit. The SC106 Transceiver is, however, capable of half duplex operation. Under this condition it is desirable to have the tuning network in and matched to the antenna during transmit mode, and the network bypassed for receive mode. This situation is accommodated by internally grounding connecting pin M of connector J2. When this is done, the bypass relay is controlled by the Transceiver Keyline (in Transmit Mode the tuning network is in, while in Receive Mode the network is automatically switched out).

4.4 DISCRIMINATOR ASSEMBLY

A schematic of the Discriminator is shown in Figure 4-5. This unit contains the phase detector, resistance detector and power detector.

4.4.1 Phase Detector

When the antenna has been properly tuned or matched by the reactive elements in the SC400, the SC400 will present a purely resistive 50 ohm load to the transmitter. If the antenna is not properly tuned, the impedance at this point will be something other than 50 ohms and either inductive or capacitive.

The function of the phase detector is to sense the reactive component and to provide a proportional DC output to the servo system that will drive the variable capacitor such that the condition is corrected.

Refer to Figure 4-6 for the following discussion. The discriminator assembly is constructed such that the antenna current induces a voltage in transformer T1. A2T1 and A2T2 function as step up transformers to provide additional sensitivity. A2T2 is constructed with a center tap so that its two outputs, as referenced to the center tap, are equal in voltage and 180° out of phase with each other. C1 and the combination of A2R1 and A2R2 form a divider which produces a reference voltage at the center tap of A2T2 that will be 90° out of phase with the line voltage at this point. The vector sum of this reference voltage and the induced voltages in the windings of A2T2 are detected by A2CR1 and A2CR2, respectively, and summed by A2R4. A2R4 is adjusted such that the circuit is perfectly symmetrical.

Because of this symmetry, the phase detector output at the wiper of A2R4 will be at a null (zero volts) when the antenna impedance presents a purely resistive load, as in

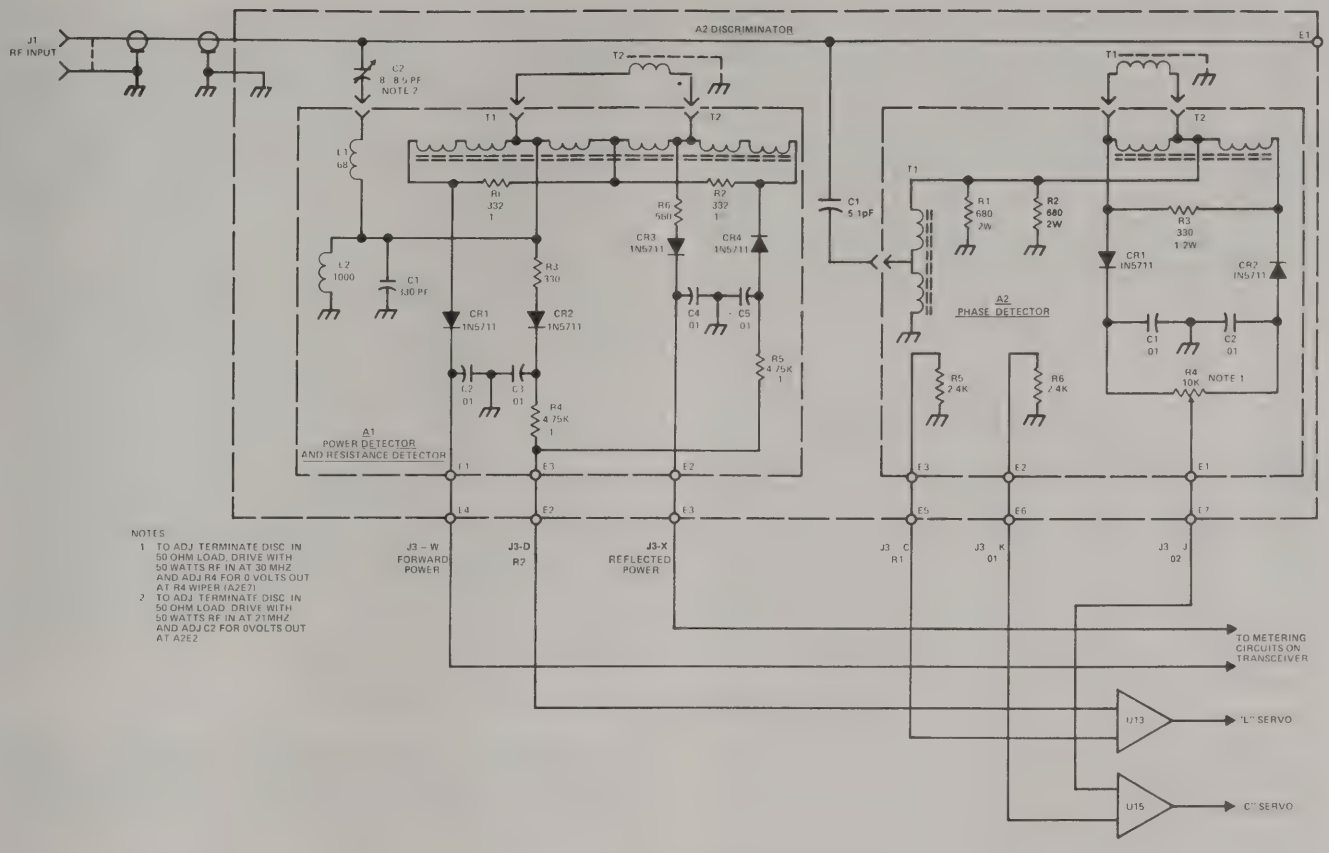


FIGURE 4-5. Discriminator Schematic.

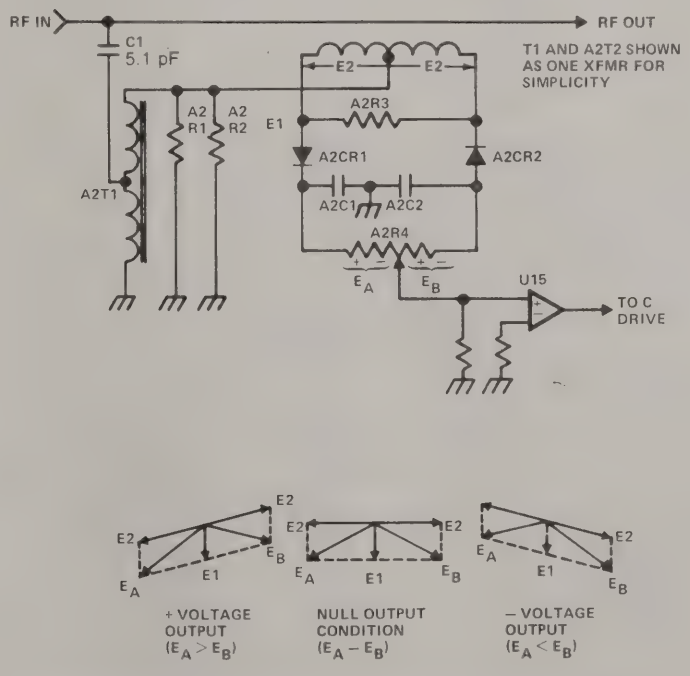


FIGURE 4-6. Simplified Phase Detector Schematic.

the "tuned" condition. Any other antenna condition would cause vector sum voltages to produce either a positive or a negative voltage output as a function of this phase difference. With a greater vector sum voltage through A2CR1, a positive voltage would be present at the wiper of A2R4 and would cause the servo system to drive C1 toward maximum capacitance. With a greater vector sum voltage through A2CR2, a negative voltage would be present at the wiper of A2R4 and would cause the servo system to drive C1 toward minimum capacitance.

4.4.2 Resistance Detector

Figure 4-7 is a simplified diagram of the resistance detector circuit. Figure 4-5 includes the complete resistance detector. The function of the resistance detector is to provide a DC output to the inductor servo amplifier that is indicative of the resistive component of the line impedance. The DC output will be zero when the resistive component is the desired 50 ohms, negative when the resistive component is less than 50 ohms, and positive when the resistive component is greater than 50 ohms.

Capacitors C2 and A1C1 form a capacitive voltage divider. The voltage across A1C1, shown as E_1 on the diagram, is in phase with and proportional to the line voltage. This voltage is detected by A1CR2, peak filtered by A1C3, and will produce a positive voltage across A1R4 at the output. Transformers T2, A1T1, and A1T2 are shown combined for simplicity. The voltage induced in this transformer combination by the line current will be twice the voltage of E_1 and of opposite polarity. This voltage is shown as E_2 in the diagram. The vector sum of the outputs from the transformer (E_2), and the divider (E_1), is detected by diode A1CR4, peak filtered by A1C5, and appears as a negative voltage across A1R5. The algebraic sum of the positive voltage across A1R4, and the negative voltage across A1R5, will produce an appropriate output as follows: A coupler input impedance of less than 50 ohms would cause a higher RF line current, and therefore increase the value of E_2. This condition would cause a negative output at A2E2 and would cause the servo to drive the variable inductor toward maximum inductance to force the resistance component of the SC400 input impedance toward 50 ohms. A higher SC400 input impedance would cause a lower antenna current, reduce the value of E_2, cause a positive resistance detector output to the servo, and drive the variable inductor toward minimum inductance such that the condition is corrected.

4.4.3 Power Detectors

Refer to Figure 4-5. CR1 and CR3 on the A2A1 Power Detector and Resistance Detector Assembly detect representative samples of the forward and reflected power, respectively.

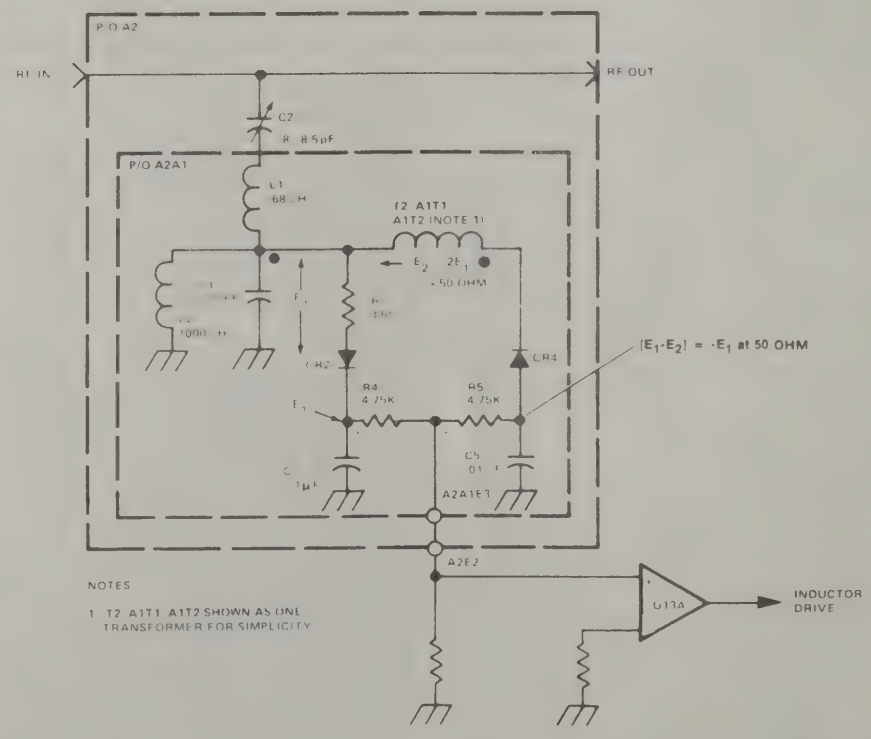


FIGURE 4-7. Simplified Resistance Detector Schematic.

The forward power voltage is developed as follows: C2 and A1C1 form a capacitive voltage divider. The voltage across A1C1 is in phase and equal in magnitude at 50 + j0 ohms (the tune point) to the voltage developed across the first two sections of A1T1. These voltages are added vectorially, rectified by A1CR1, peak filtered by A1C2, and appear as a voltage proportional to the forward output power at E4.

The reflected power metering voltage is developed as follows: the voltage across A1C1 is 180° out of phase and equal in magnitude to the voltage developed in the last section of A1T1 and the adjacent section of A1T2. These voltages are also added vectorially, and because they are 180° out of phase, at 50 + j0 ohms (the tune point), the vectorial sum would be zero volts. Any mis-match, or condition other than 50 + j0 ohms would cause a proportional phase shift, or change in magnitude, and be detected by A1CR3 as a reflected power voltage. This voltage is peak filtered by A1C4 and will appear as a positive voltage output at E3 on the Discriminator Assembly.

4.5 CONTROL LOGIC ASSEMBLY

The Control Logic Assembly pc board contains the coupler logic circuits, servo amplifier, and power supply. A detailed schematic of this board is shown in Section VI.

4.5.1 Power Supply

Figure 4-8 shows the power supply functions contained in the Control Logic Assembly. Note that Q1, the series regulator, is shown in this schematic for clarity even though it is physically mounted external to the pc board because of heat dissipation requirements.

The 22 through 36 VDC SC400 input voltage originates through the compatible transceiver. The +24 VDC regulated output is used primarily with the servo drive system. The plus and minus 10 VDC voltages are used for the logic functions. All voltages are referenced to chassis ground and can by checked at test points on the pc board.

TP3 = +24 VDC; TP4 = −10 VDC; TP7 = +10 VDC

4.5.2 Servo Control

4.5.2.1 Variable Inductor Control Servo

Refer to Figure 4-9. Control information for the variable inductor servo originates in the resistance detector as previously described. The control voltage at the noninverting (+) input to U13A can vary between a negative and a positive voltage as a function of the resistance detector output. The output of U13A is applied to the noninverting of input of U13B and to the inverting input of U14A such that U13B and U14B will have equal but opposite voltages.

Assuming the U13B output voltage to be negative and the U14B output voltage to be positive, the variable inductor would be driven toward maximum as follows: The negative output voltage from U13B would bias on PNP transistors Q3 and Q4, and the positive output voltage from U14B would bias on NPN transistors Q6 and Q5. With this polarity voltage on the inductor

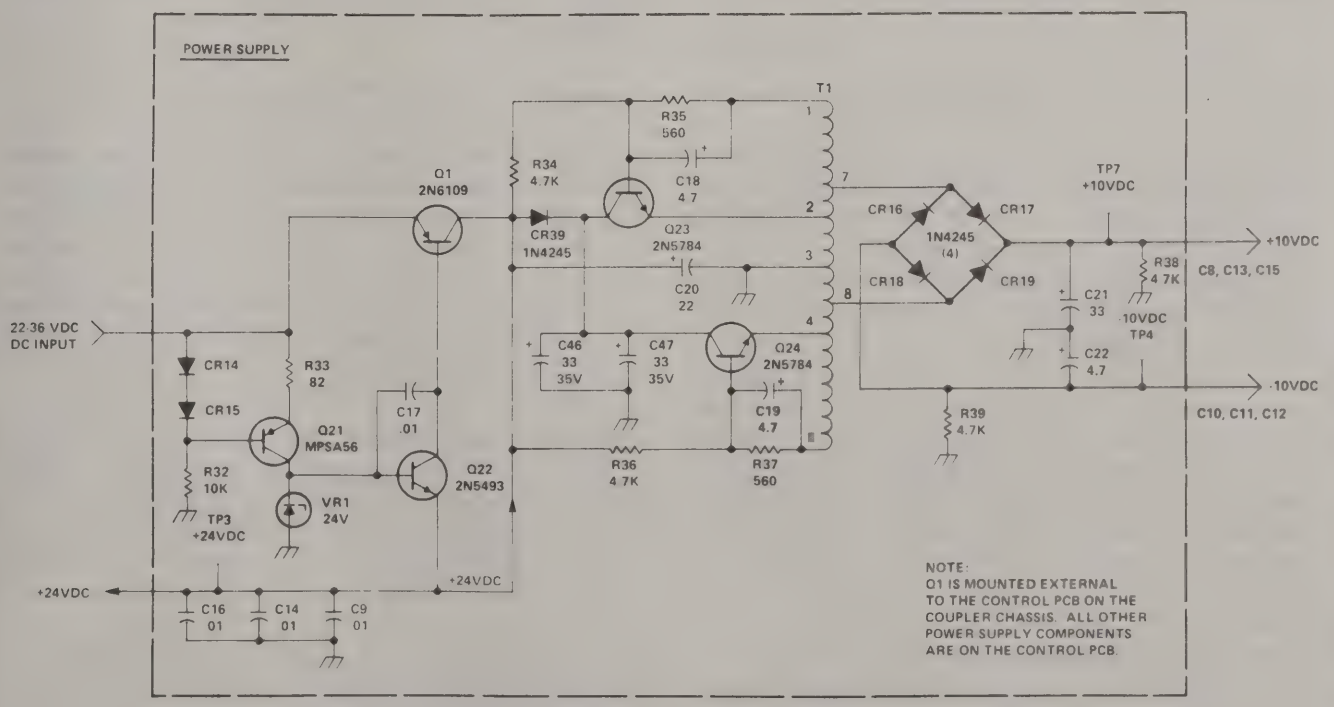


FIGURE 4-8. Power Supply Schematic.

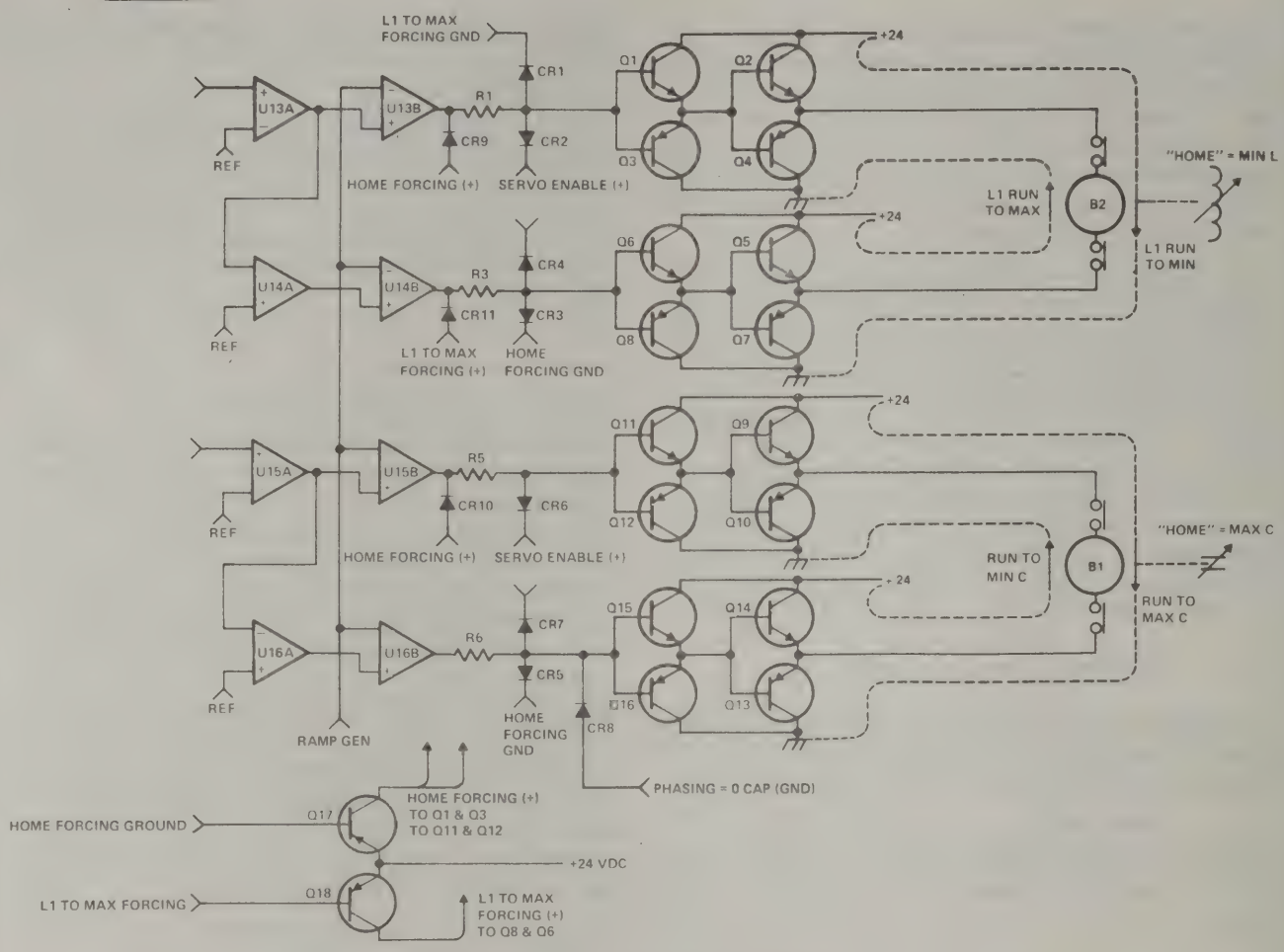


FIGURE 4-9. Servo Control Diagram.

servo drive motor, the variable inductor will be driven toward maximum. Note that L1 to Maximum forcing logic (ground through CR1 and [+] through CR11), would also drive the inductor toward maximum by similarly biasing Q3, Q4, Q5, and Q6. These same conditions would bias off Q1, Q2, Q7, and Q8, the "L1 Run to Minimum" drive transistors.

A resistance detector output that would cause the U13B output to be positive, and the U14B output to be negative, would bias on Q1, Q2, Q7, and Q8, and cause the variable inductor to be driven toward minimum. Note that minimum inductance is the "Home" position, and that the "Home" logic levels introduced through CR5 and CR3 would also cause drive transistor bias conditions that would drive the variable inductor in this direction.

4.5.2.2 Variable Capacitor Control Servo

Refer to Figure 4-9. The capacitor control servo operates just like the variable inductor servo described in the previous paragraph with the notable exception that the phase detector is used as the sensor and drive voltage source. The phase detector output will also vary between a negative and a positive voltage as a function of the detune condition. This voltage will cause the capacitor drive servo to run either clockwise or counterclockwise until a tune condition is effected as evidenced by zero volts or a null in the phase detector output.

4.5.2.3 Ramp Oscillator

See Figure 4-10. The ramp oscillator functions in combination with the servo control signal from the respective detector to produce time modulated servo motor drive voltages, as shown. By pulsing the 24 VDC motor drive voltage at a pulse width proportional to the error signal; maximum motor efficiency and proportional control are maintained, even at low error voltage levels.

Recall that the phase or resistance detector outputs can be either positive or negative and will drive the servo motors either clockwise or counterclockwise. We will consider both directions, but only for the variable in-

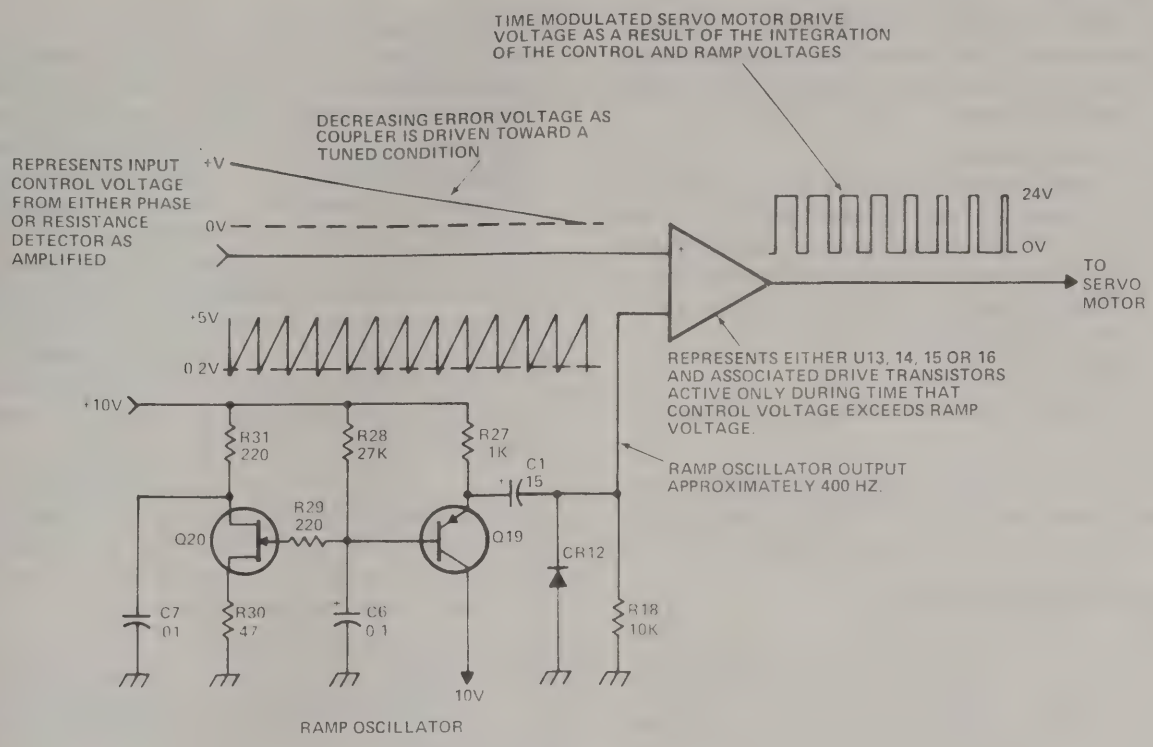


FIGURE 4-10. Ramp Oscillator.

ductor because both systems operate in the same manner. Referring to Figure 4-9, notice that U13 and U14 are both dual operational amplifiers. The resistance detector output is connected to the non-inverting (+) input of U13A. The inverting input of U13A is tied to a fixed reference voltage.

Let us consider a positive input from the resistance detector. The output of U13A would, in this instance, be some finite positive value as a function of the gain of U13A and the specific input level. This positive level is applied directly to the non-inverting (+) input of U13B, and also to the inverting input of U14A. At this point there would be equal but opposite signal levels at the non-inverting input of U13B and U14B. Note that the ramp generator output is fed to the inverting input of U13B and U14B. The ramp voltage is a 400 Hz voltage (approximately) that varies between − 0.2 and + 5 VDC.

With this ramp voltage applied to the inverting input of U13B, and the positive voltage (in this instance) at the non-inverting input, U13B would produce a positive output, but only during the period of time that the signal voltage exceeds the ramp voltage. A high signal voltage would exceed the ramp voltage for a greater period than would a small signal voltage. During the period that the U13A output is positive, Q1 and Q2 would be biased on and apply +24V to the servo motor as shown in Figure 4-9, note that the ground path must also be completed through Q7 and Q8.

Q7 and Q8 will, in this instance, be on continuously — as opposed to the pulsing action on the positive side. This is accomplished as follows: the positive output of U13A is inverted by U14A and compared with the ramp voltage at U14B. In this instance, the negative signal voltage would always be more negative than the positive ramp voltage, and as a consequence, the U14 output would be negative as long as the signal voltage is negative. This condition would provide a continuous ground path for the pulsating +24 VDC run-to-minimum polarity voltage applied through Q1 and Q2.

A negative input at U13A would control the motor circuit in a similar manner for operation in the opposite direction. In this instance, however, Q3 and Q4 would provide a continuous ground, and Q5 and Q6 would pulse the +24 VDC side.

4.5.2.4 L1 Drive Assembly

The heart of the variable inductor drive assembly is a 24 VDC motor that will run in either direction, dependent on the polarity of the drive voltage previously discussed. There are two microswitches, S1 and S2, mechanically coupled to the assembly. S1 is positioned and adjusted such that it will be opened as the variable inductor reaches the maximum inductance position. When S1 opens, +24 VDC driving the motor is removed, and at the same time this side of the motor is grounded so that 24V on the other side of the motor can run the inductor out of this position and toward minimum inductance. S2

serves a similar function at the minimum inductance end of the inductor. CR3 provides an "L1 at minimum" signal to the "Elements-Home" logic on the Control Logic Assembly PC Board.

4.5.2.5 C1 Drive Assembly

The variable capacitor drive assembly operates similar to the L1 drive assembly and includes similar end stop switches. CR3 on the switch assembly also feeds an "Elements Home" signal to the same NOR gate fed by the L1 at minimum signal. Note, however, that the C1 "Home" position is maximum capacitance.

4.5.3 Control Logic Circuits

Logic Circuits are shown in a functional diagram in Figure 4-11.

Circuit explanations include logic symbols and, in some instances, boolean expressions. The following summary is included to define the meaning of these terms.

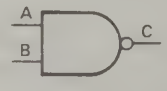
- BOOLEAN EXPRESSIONS

(1) $A + B = C$ — The plus sign should be read "OR" in a boolean expression. This expression should be read "A OR B = C".

(2) $A \cdot B = C$ — The black dot should be read "AND" in a boolean expression. This expression should be read "A AND B = C".

(3) $\overline{A} \cdot \overline{B} = C$ — The superscript bar is the symbol for negation in a boolean expression. This expression should be read, "NOT A AND NOT B = C".

- LOGIC

(1) 

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

This NAND gate performs an "AND" function with high level inputs and an "OR" function with low level inputs. The symbols used include an indication of the circuit function performed to produce the desired output.

(2)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

This NOR gate performs an "AND" function with two low level inputs and an "OR" function with any high level input. The symbols used include an indication of the circuit function performed to produce the desired output.

4.5.3.1 Rechannel Logic

Refer to Figure 4-12 and to the related simplified diagram on Figure 4-11. "Recycle" (gnd), and "Recycle" (+) signals are generated by U10A and U10D in response to a rechannel ground signal or at initial power on. The SC106 will generate a ground pulse signal whenever a new frequency is selected. C30 charges through R69 to stretch the "Recycle" output when the rechannel ground input is removed. C30 discharges through CR24 to provide fast response to rechannel ground inputs. C29 provides a low impedance path to ground at power on to cause a momentary low at U10A and generate a "Recycle" signal at initial power on. The time constant of C29 and R68 prevents recycling as a result of momentary power interruptions.

The "Recycle" (gnd) signal resets fault circuitry, resets sequence mode circuitry to "Homing" mode, and unlatches keyhold circuitry. The "Recycle" (+) signal is generated simultaneously and is used to reset the 25 second fault timer, and tuning mode flip-flop.

4.5.3.2 Elements Home Logic

Refer to Figure 4-13 and to the related simplified diagram on Figure 4-11. The "Elements Home" signal is generated by NOR gate U3A. This device uses low level inputs to perform an "AND" function such that the "Elements Home" (+) signal will be present only when C1 and L1 are at the "Home" position. When C1 reaches the "Home" (maximum capacitance) position, S2 will be closed and complete the biasing circuit, that includes R78 and R79, to ground. This reduces the bias at U3-1 from +10 VDC to a ground logic level. S2 on the L1 assembly provides a similar function. S2 on both assemblies must be closed to generate the "Elements Home" (+) logic signal. This signal is fed to the sequence mode logic and will switch the sequence mode logic from the "Homing" mode to the "Homed"mode.

4.5.3.3 Sequence Mode Logic and Control

Refer to Figure 4-14 and to the related simplified diagram on Figure 4-11. The Sequence Mode Logic consists of the following functions: "Homing", "Homed", "Tuning", and "Tuned". The "Homing", "Tuning", and "Tuned" functions are generated through NAND gates configured as RS type flip-flops. The "Homed" function is generated by anding the "Elements Home" (+) signal and the "Tuning" (gnd) signal in part of U5D.

$$\text{RECYCLE (GND)} \bullet \overline{\text{ELEMENTS HOME}} = \text{HOMING}$$

The "Homing" signal will be generated whenever a "Recycle" (gnd) signal is received. The "Homing" (+) output biases on Q44 and Q45 and will drive both the variable inductor and capacitor servos to the "Home" position. When the tuning elements have reached their "Home" positions an "Elements Home" (+) signal will be produced (see paragraph 4.5.3.2) at U5B. Note that U5B has both inputs tied together such that it functions

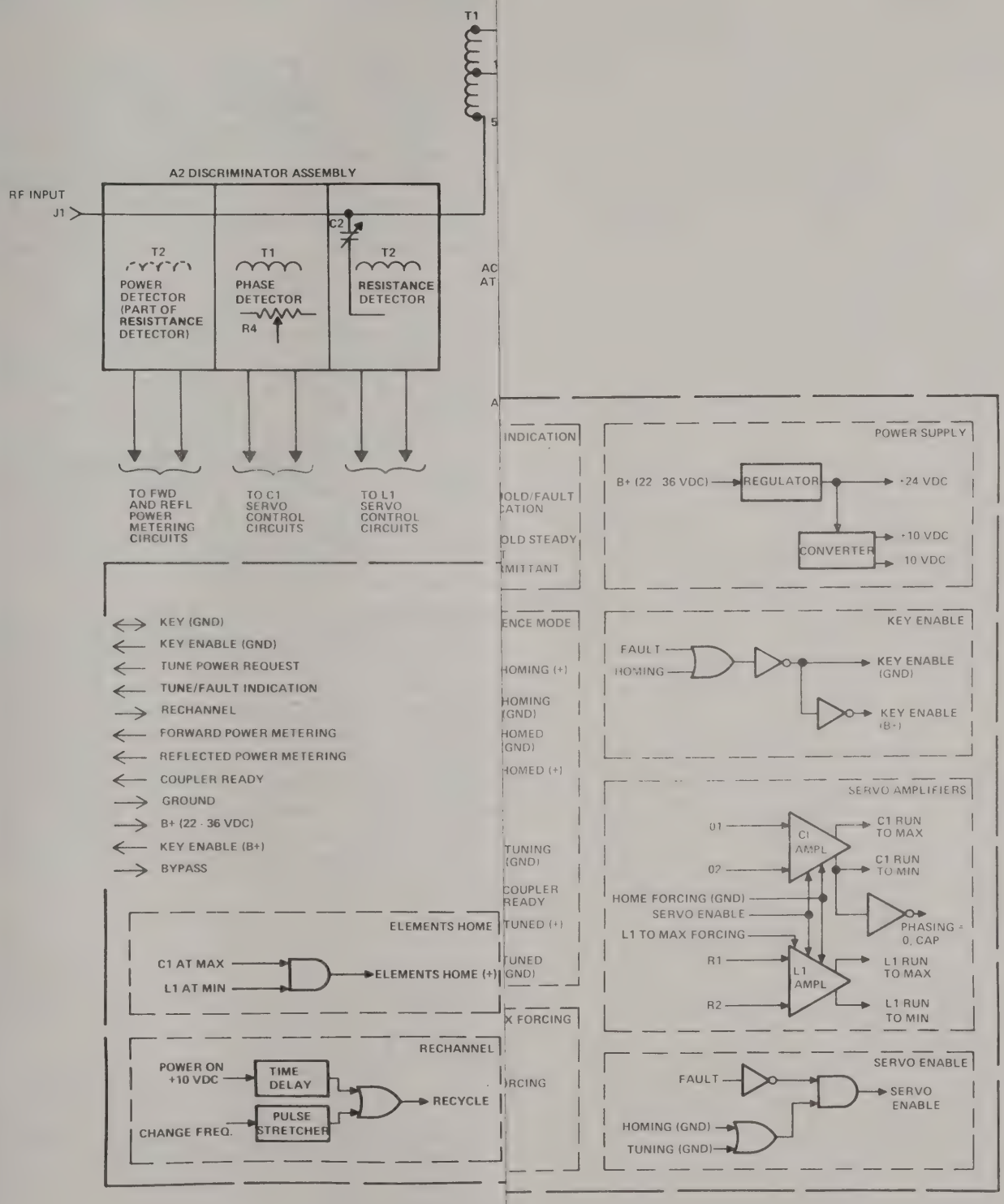


FIGURE 4-11. Antenna Coupler Functional Diagram.

serves a similar function at the minimum inductance end of the inductor. CR3 provides an "L1 at minimum" signal to the "Elements-Home" logic on the Control Logic Assembly PC Board.

4.5.2.5 C1 Drive Assembly

The variable capacitor drive assembly operates similar to the L1 drive assembly and includes similar end stop switches. CR3 on the switch assembly also feeds an "Elements Home" signal to the same NOR gate fed by the L1 at minimum signal. Note, however, that the C1 "Home" position is maximum capacitance.

4.5.3 Control Logic Circuits

Logic Circuits are shown in a functional diagram in Figure 4-11.

Circuit explanations include logic symbols and, in some instances, boolean expressions. The following summary is included to define the meaning of these terms.

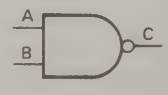
- BOOLEAN EXPRESSIONS

(1) $A + B = C$ — The plus sign should be read "OR" in a boolean expression. This expression should be read "A OR B = C".

(2) $A \cdot B = C$ — The black dot should be read "AND" in a boolean expression. This expression should be read "A AND B = C".

(3) $\overline{A} \cdot \overline{B} = C$ — The superscript bar is the symbol for negation in a boolean expression. This expression should be read, "NOT A AND NOT B = C".

- LOGIC

(1) 

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

This NAND gate performs an "AND" function with high level inputs and an "OR" function with low level inputs. The symbols used include an indication of the circuit function performed to produce the desired output.

(2)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

This NOR gate performs an "AND" function with two low level inputs and an "OR" function with any high level input. The symbols used include an indication of the circuit function performed to produce the desired output.

4.5.3.1 Rechannel Logic

Refer to Figure 4-12 and to the related simplified diagram on Figure 4-11. "Recycle" (gnd), and "Recycle" (+) signals are generated by U10A and U10D in response to a rechannel ground signal or at initial power on. The SC106 will generate a ground pulse signal whenever a new frequency is selected. C30 charges through R69 to stretch the "Recycle" output when the rechannel ground input is removed. C30 discharges through CR24 to provide fast response to rechannel ground inputs. C29 provides a low impedance path to ground at power on to cause a momentary low at U10A and generate a "Recycle" signal at initial power on. The time constant of C29 and R68 prevents recycling as a result of momentary power interruptions.

The "Recycle" (gnd) signal resets fault circuitry, resets sequence mode circuitry to "Homing" mode, and unlatches keyhold circuitry. The "Recycle" (+) signal is generated simultaneously and is used to reset the 25 second fault timer, and tuning mode flip-flop.

4.5.3.2 Elements Home Logic

Refer to Figure 4-13 and to the related simplified diagram on Figure 4-11. The "Elements Home" signal is generated by NOR gate U3A. This device uses low level inputs to perform an "AND" function such that the "Elements Home" (+) signal will be present only when C1 and L1 are at the "Home" position. When C1 reaches the "Home" (maximum capacitance) position, S2 will be closed and complete the biasing circuit, that includes R78 and R79, to ground. This reduces the bias at U3-1 from +10 VDC to a ground logic level. S2 on the L1 assembly provides a similar function. S2 on both assemblies must be closed to generate the "Elements Home" (+) logic signal. This signal is fed to the sequence mode logic and will switch the sequence mode logic from the "Homing" mode to the "Homed"mode.

4.5.3.3 Sequence Mode Logic and Control

Refer to Figure 4-14 and to the related simplified diagram on Figure 4-11. The Sequence Mode Logic consists of the following functions: "Homing", "Homed", "Tuning", and "Tuned". The "Homing", "Tuning", and "Tuned" functions are generated through NAND gates configured as RS type flip-flops. The "Homed" function is generated by anding the "Elements Home" (+) signal and the "Tuning" (gnd) signal in part of U5D.

RECYCLE (GND) • $\overline{\text{ELEMENTS HOME}}$ = HOMING

The "Homing" signal will be generated whenever a "Recycle" (gnd) signal is received. The "Homing" (+) output biases on Q44 and Q45 and will drive both the variable inductor and capacitor servos to the "Home" position. When the tuning elements have reached their "Home" positions an "Elements Home" (+) signal will be produced (see paragraph 4.5.3.2) at U5B. Note that U5B has both inputs tied together such that it functions

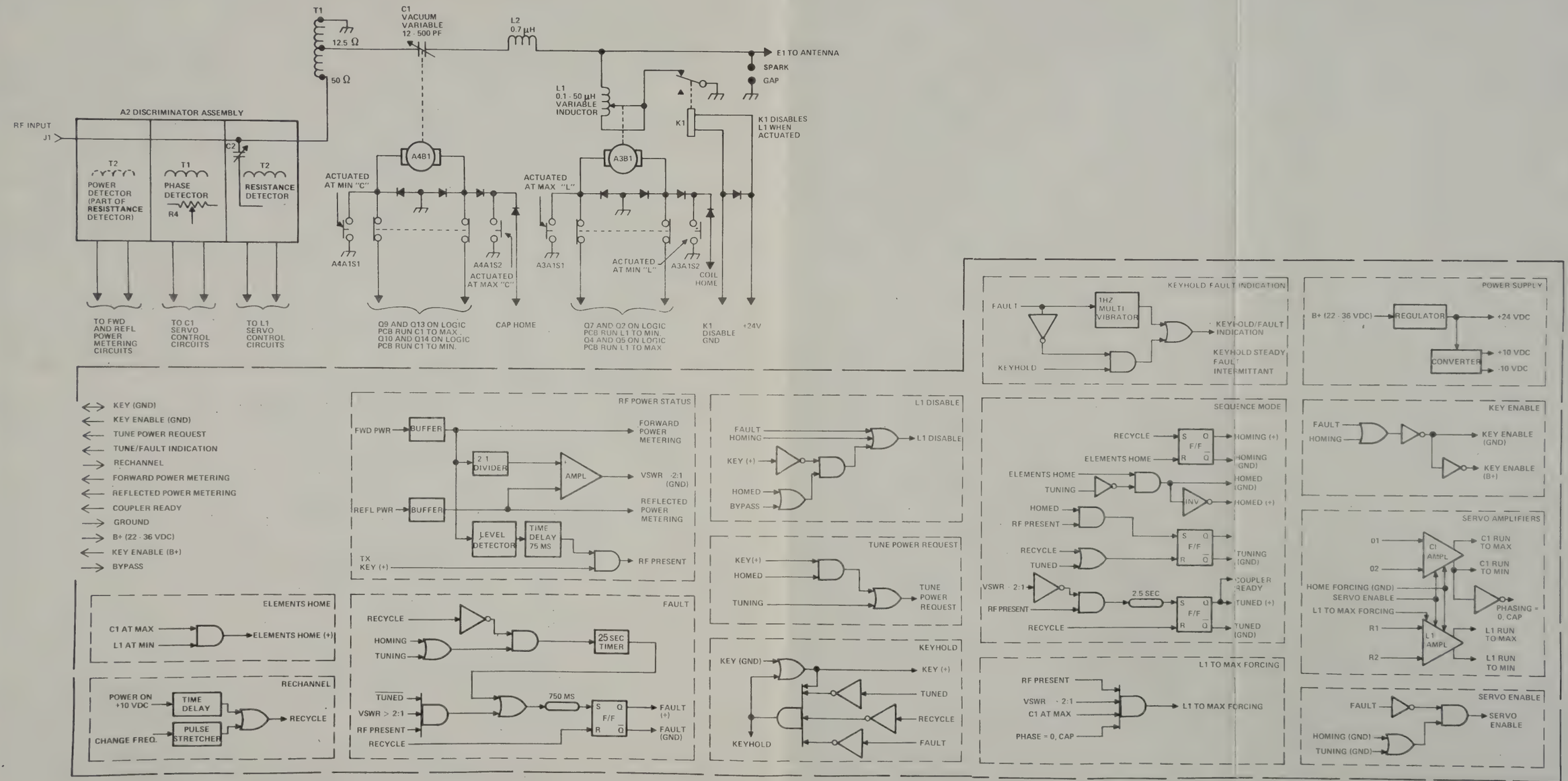


FIGURE 4-11. Antenna Coupler Functional Diagram.

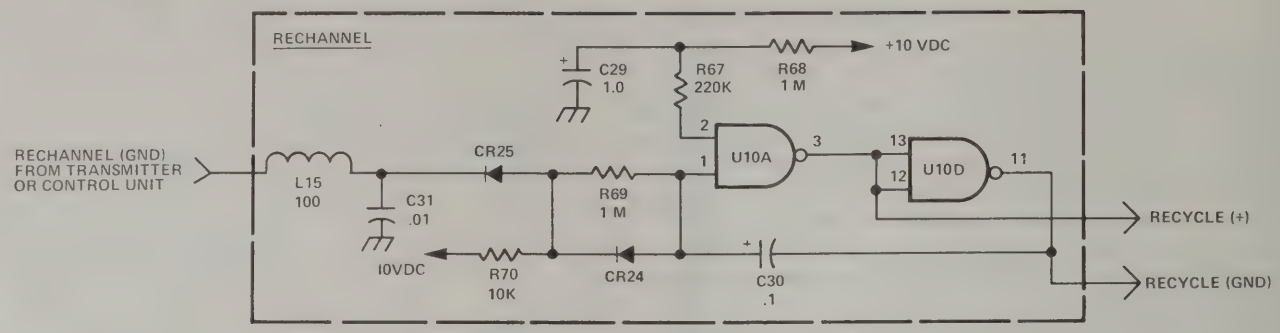


FIGURE 4-12. Rechannel Pulse Generation.

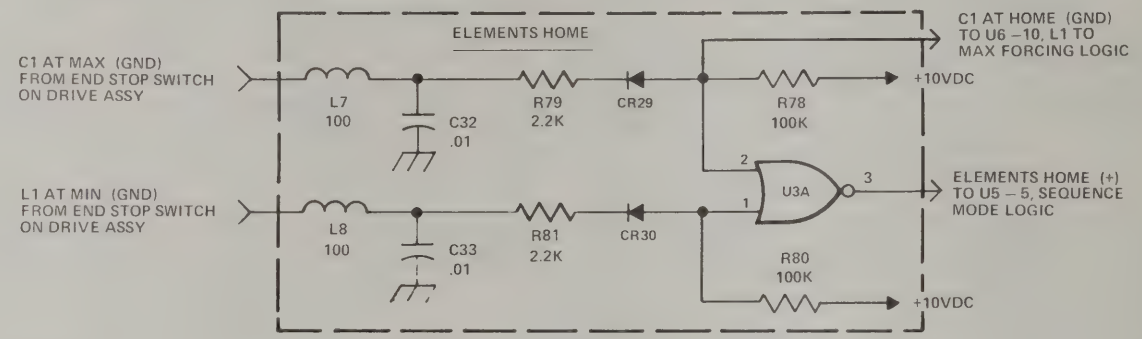


FIGURE 4-13. Elements Home Logic.

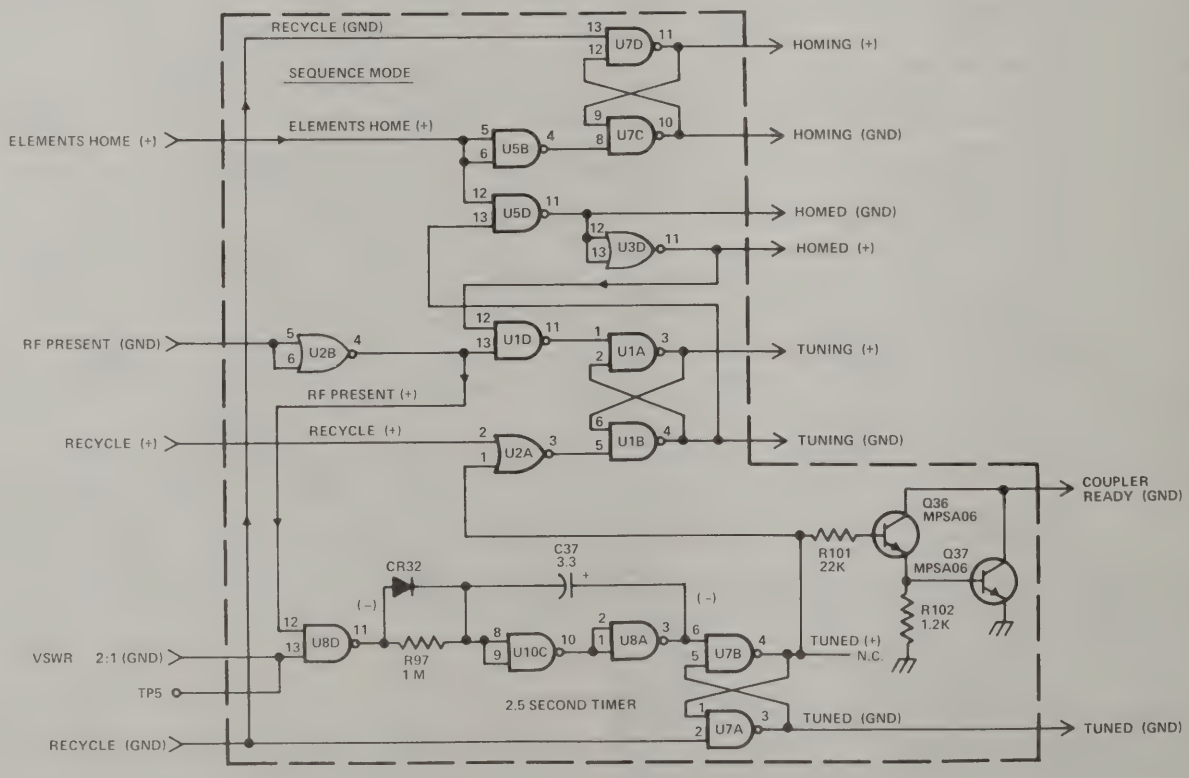


FIGURE 4-14. Sequence Mode Logic & Control.

as an inverter. This signal resets the "Homing" RS flip-flop (U7C & D) and switches the "sequence" mode to "Homed."

HOMED • RF PRESENT = TUNING

The "Tuning" signal will be generated when the "Homed" and "RF Present" functions are present. This signal is used in the generation of the "Tune Power Request" signal and in the fault logic. The "Tuning" mode flip-flop is reset such that it is out of the "Tuning" mode when the "Sequence" mode switches to the "Tuned" mode or when the coupler is rechanneled.

RF PRESENT (+) • $\overline{\text{VSWR} > 2{:}1}$ = TUNED (+)

The "Tuned" signal will be present when the RS flip-flop composed of U7A and B is "set" to this condition by an "RF Present" condition in coincidence with a VSWR of less than 2:1 (when VSWR > 2:1 signal goes positive). Note that a delay has been provided in series with the U8D anding function. This delay provides additional time for fine tuning after a VSWR < 2:1 condition has been achieved. The "Tuned" (+) signal turns on Q36 and Q37 to provide a "Coupler Ready" (gnd). The "Tuned" flip-flop will be reset by a "Recycle" (gnd) signal.

4.5.3.4 Servo Enable and Control Logic

Refer to Figure 4-15 and to the related simplified diagram on Figure 4-11. The "Servo Enable" (+) signal will be generated whenever RF is present or a "Homed" condition exists and there is no fault condition. When the "Servo Enable" (+) condition is not present, the outputs from the servo amplifiers, U13B, U14B, U15B, and U16B, will be shorted to ground through CR2, CR4, CR6 and CR7 respectively and Q43. With a "Servo Enable" (+) condition, these diodes are biased off and the servo amplifier outputs will control the drive transistors. This allows the coupler to perform "surveillance tuning". This means that variable inductor L1 and variable capacitor C1 will automatically be adjusted to a new tune point to compensate for small changes in antenna impedance or operating frequency. This occurs in the "Tuned" mode, without the necessity for recycling through the complete tuning sequence.

4.5.3.5 L1 Disable and Control Logic

Refer to Figure 4-16 and to the related simplified diagram on Figure 4-11. The L1 disable and control logic group controls K1 on variable inductor L1 by controlling its path to ground through Q49. Energizing K1 disables L1 by opening the ground side of the coil. This effectively bypasses the SC400 tuning network for monitoring receive signals at frequencies other than that to which the coupler is tuned.

Variable inductor L1 is disabled as follows. Q48 and Q49 are turned on whenever the base of Q48 goes high, as would be the case with a plus output from U9. L1 will be disabled under the following conditions: A "Fault" (gnd) at U9-10, or a "Homing" (gnd) at U9-9, or no "Key" (+) and a "Homed" (gnd), or a "Key" (+) and a "Bypass" (gnd) through U11.

4.5.3.6 Tune Power Request and Control Logic

Refer to Figure 4-17 and to the related simplified diagram on Figure 4-11. A "Tune Power Request" ground signal will be placed on the control line whenever Q35 is turned on. Q35 and Q50 will be turned on when the base of Q50 goes high in response to a plus output from U5A. Tune power will be requested whenever a "Tuning" (gnd) signal is present at U5A or when "Key" (+), and "Homed" (+) signals are present from U11C. These conditions should occur after the tuning elements have reached the home position and the system is keyed. The "Tune Power Request" signal is removed after the tuning elements have reached the "Tuned" position.

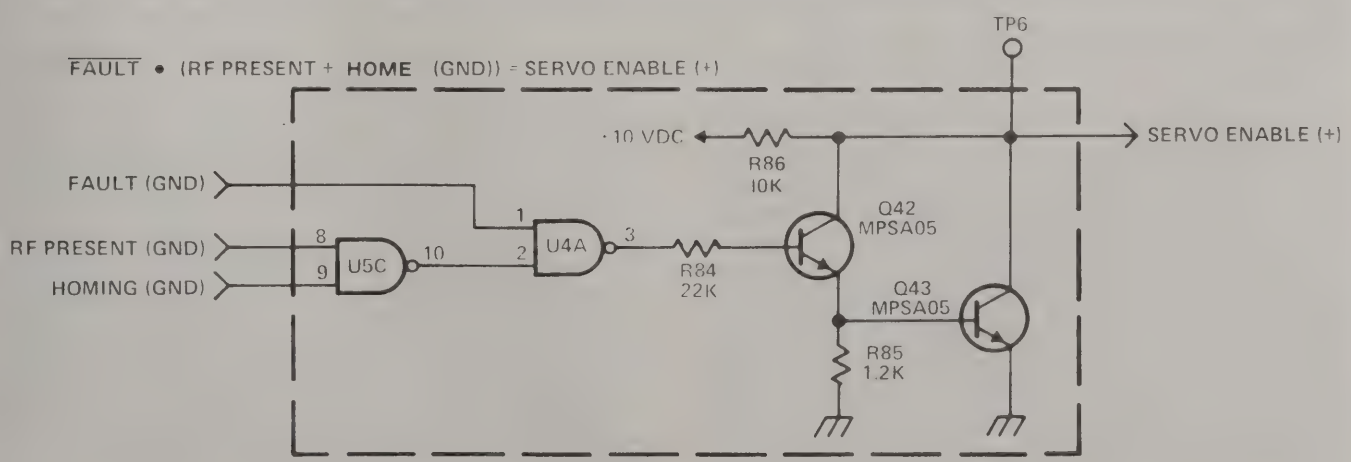


FIGURE 4-15. Servo Enable & Control Logic.

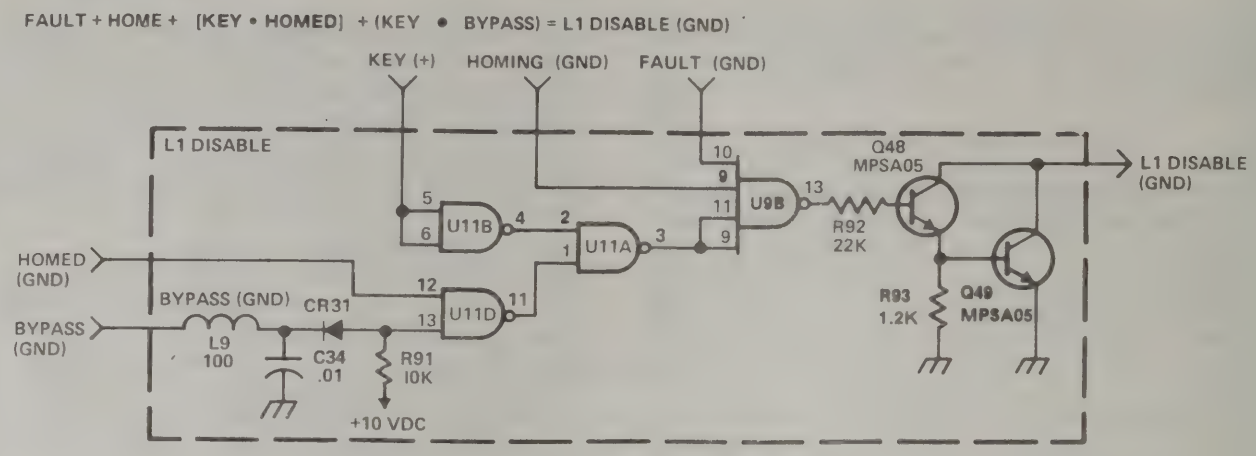


FIGURE 4-16. L1 Disable & Control Logic.

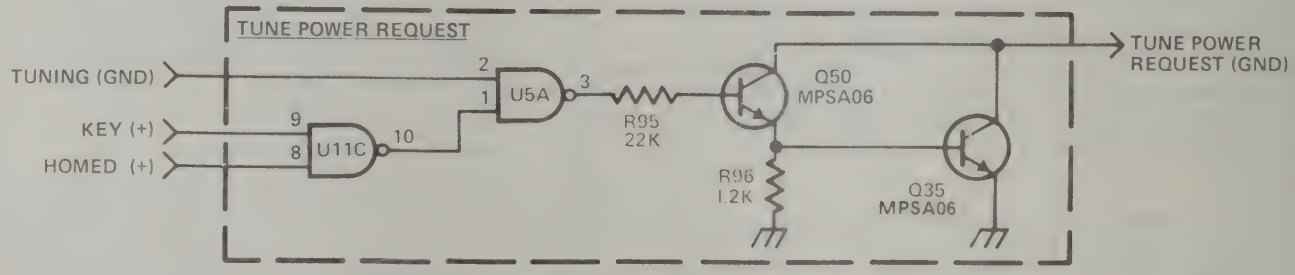


FIGURE 4-17. Tune Power Request & Control Logic.

The "Tune Power Request" condition functions to automatically force a compatible transmitter to produce an unmodulated carrier when the transmitter is keyed. This produces a 25 watt unmodulated carrier when the SC106 is keyed. Q35 can sink up to 100 mA DC and can withstand up to 36 VDC open circuit voltage (uncommitted collector) when not requesting tune power.

4.5.3.7 Key Enable and Disable Control Logic

Refer to Figure 4-18 and to the related simplified diagram on Figure 4-11. The "Key Enable" signal from the SC400 and keyline are both required to enable the power amplifier to produce RF power output. The "Key Enable" logic actually functions to automatically disable the RF output until all prerequisite conditions are met. NOR gate U3B will disable the key enable function in the presence of a "Fault" condition or a "Homing" condition. The "Key Enable" function is available as both a ground and as B+. The "Key Enable" (B+) is capable of driving a 250 mA DC load. When disabled, the line is open (uncommitted collector). The "Key Enable" (gnd) is capable of sinking 250 mA DC. Both outputs are available at the control cable output.

4.5.3.8 Key Hold Logic and Control

Refer to Figure 4-19 and to the relate simplified diagram on Figure 4-11. U9A is a part of a dual 4 input NAND gate and performs an AND function to control the "Key Hold" ground. This means that all of the inputs must be high before the output will go low. If we assume that the system is not tuned and that we do not have "Fault" or "Recycle" logic levels present, then a momentary key (gnd) condition from the transmitter would bias Q34 off and cause U9-5 to go high. With these input conditions, the U9A output would go low and generate a "Keyhold" (gnd). This ground signal will be inverted by U12A and bias on Q38 and Q39, which will hold the transmitter keyline at ground until any of the logic levels at the input of U9A change to a ground level. Recall that the "Tuned" flip-flop will be reset one second after the VSWR $< 2{:}1$ and "RF Present" conditions are met. As a consequence, a momentary key by the operator will latch the system in a keyed condition until the SC400 has either tuned, faulted, or receives a rechannel signal. The keyline through Q39 can sink up to 100 mADC, and withstand up to 36 VDC open circuit (unkeyed).

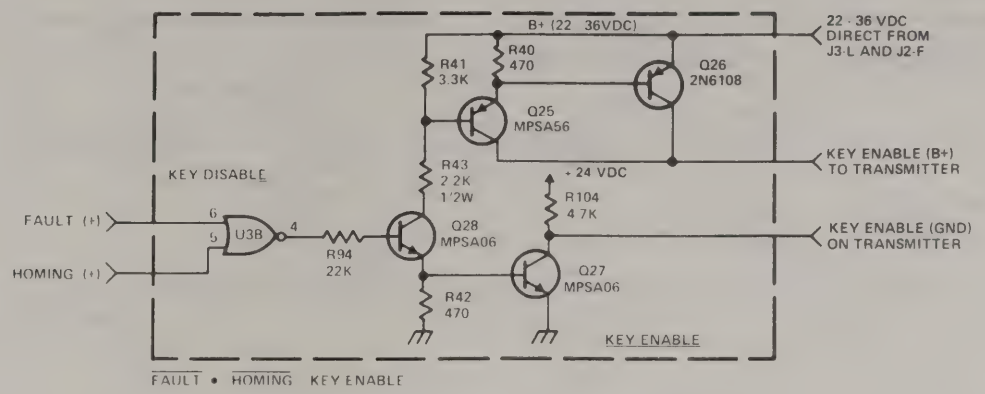


FIGURE 4-18. Key Enable & Disable.

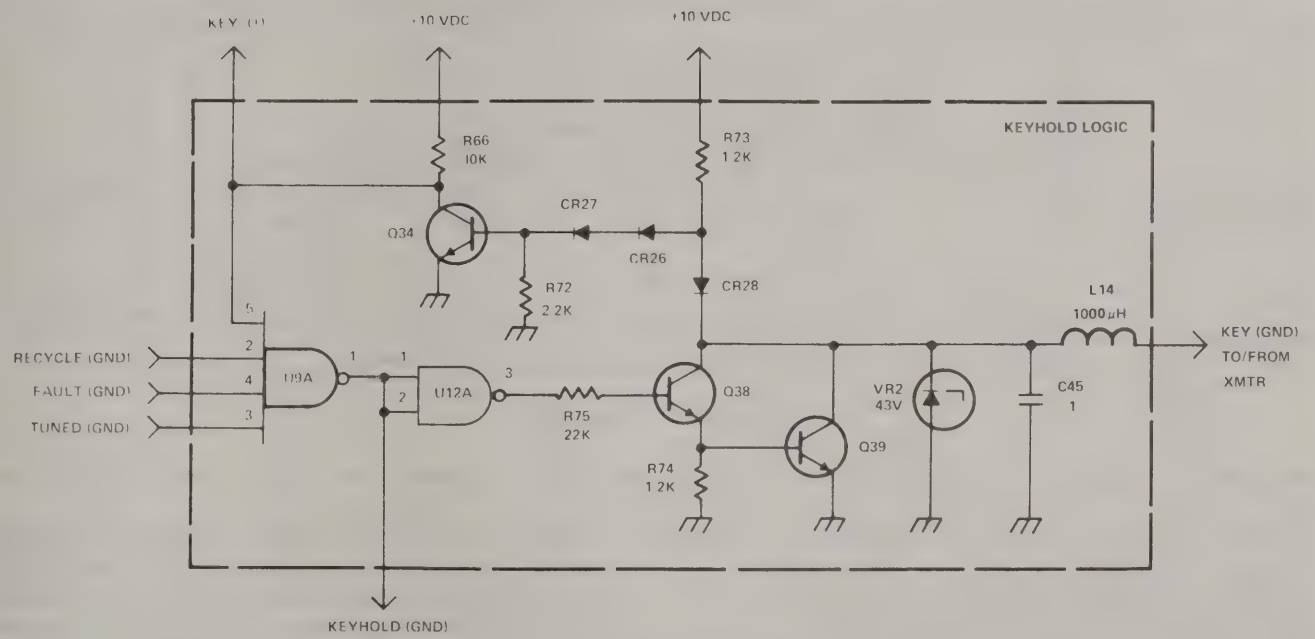


FIGURE 4-19. Keyhold Logic & Control.

4.5.3.9 Keyhold/Fault Indicator Logic and Control

Refer to Figure 4-20 and to the related simplified diagram on Figure 4-11. This signal indicates "Keyhold" or "Fault" status of the SC400. A constant +24 VDC on this line indicates that the SC400 has the system key grounded. A 24 VDC pulse at 1 Hz indicates that the coupler has faulted. The system keyline is held grounded when the elements are either homing or homed after the system has been momentarily keyed, or when the tuning elements are tuning under RF power. When the SC400 is not tuning or is not faulted the line is open, (no +24V supplied to the indicator line). In the SC106 this signal illuminates the READY light.

4.5.3.10 Fault Logic and Control

Refer to Figure 4-21 and to the related simplified diagram of Figure 4-11. U8B and U8C are configured as an RS flip-flop. A "Recycle" (gnd) signal at U8B will reset the latch and a ground at U8C will set the latch to the fault condition. Note that the "Fault" (+) output will drive the 1 Hz multivibrator, U10B and U12C, (Figure 4-20) to indicate a "Fault" condition. The 750 ms delay built into this circuit by U1C and U2C, and the combination of C41, R100, and CR33, functions to delay fault action just long enough to accommodate minor VSWR excursions during the final tune phase. The Homing/ Tuning Fault (+) input is from the 25 second timer.

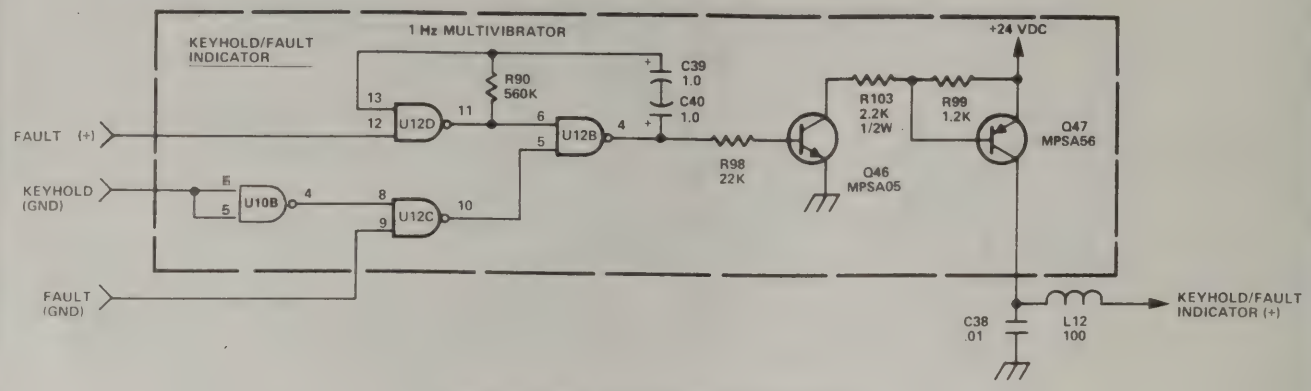


FIGURE 4-20. Keyhold/Fault Indicator.

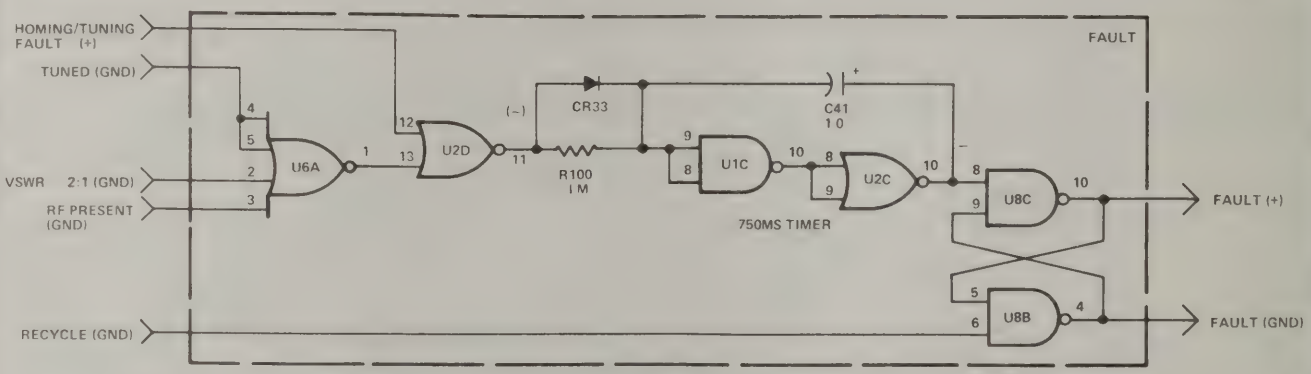


FIGURE 4-21. Fault Logic.

4.5.3.11 25 Second Timer, Homing/Tuning Fault Control

Refer to Figure 4-22 and to the related simplified diagram on Figure 4-11. This circuit will generate a "Homing/Tuning Fault" signal if the SC400 has not completed the instructed operation within 25 seconds. Q33 will be switched off and start the tuning action with a ground logic level at its base. U3C will produce a ground logic level output in the presence of either a "Tuning" (+) or a "Homing" (+) logic level at its input. When Q33 is switched off C23 starts to charge towards B+ through R46. The time constant of C23 and R46 provides an approximate 25 second delay in the generation of this function. If the SC400 does not home or tune within this time frame, the Homing/Tuning Fault signal will be generated and applied to the fault logic. The timer will be reset by a "Recycle" (+) signal at Q33 or when both the "Tuning" (+) NOT and the "Homing" (+) NOT conditions are satisfied.

4.5.3.12 RF Power Status

Refer to Figure 4-23 and to the related simplified diagram on Figure 4-11. This circuit monitors both the forward and the reflected power levels as sampled and detected by the A2A1 detector, and provides four outputs: two metering outputs, and two logic levels. Q31 and Q32 buffer the forward and reflected samples respectively. The output levels to the metering lines are calibrated to indicate 150 watts full scale on a 0 — 100 μADC meter, and 40 watts at 1/2 scale (50μA).

The forward and the reflected power levels are compared in U17A. The value of R55, R58, and R59 have been chosen such that VSWR levels less than 2:1 will produce a positive logic level, and VSWR levels greater than 2:1 will produce a ground logic level at the output of U17A.

The "RF ON" (+) threshold is established by R53 and R54 at the reference input to U17B. U17B compares the forward power output of Q31 with the reference established by voltage divider R53 and R54. Increasing the value of R54 will increase the amount of RF input power required at J1 to produce an "RF ON" (+) signal. A 1.3K resistor produces a 5 watt threshold and a 2.2K resistor produces a 15 watt threshold. R54 may be changed to generate this function at a higher power level if desired. This may be desirable to decrease the effects of a near-field transmitting antenna.

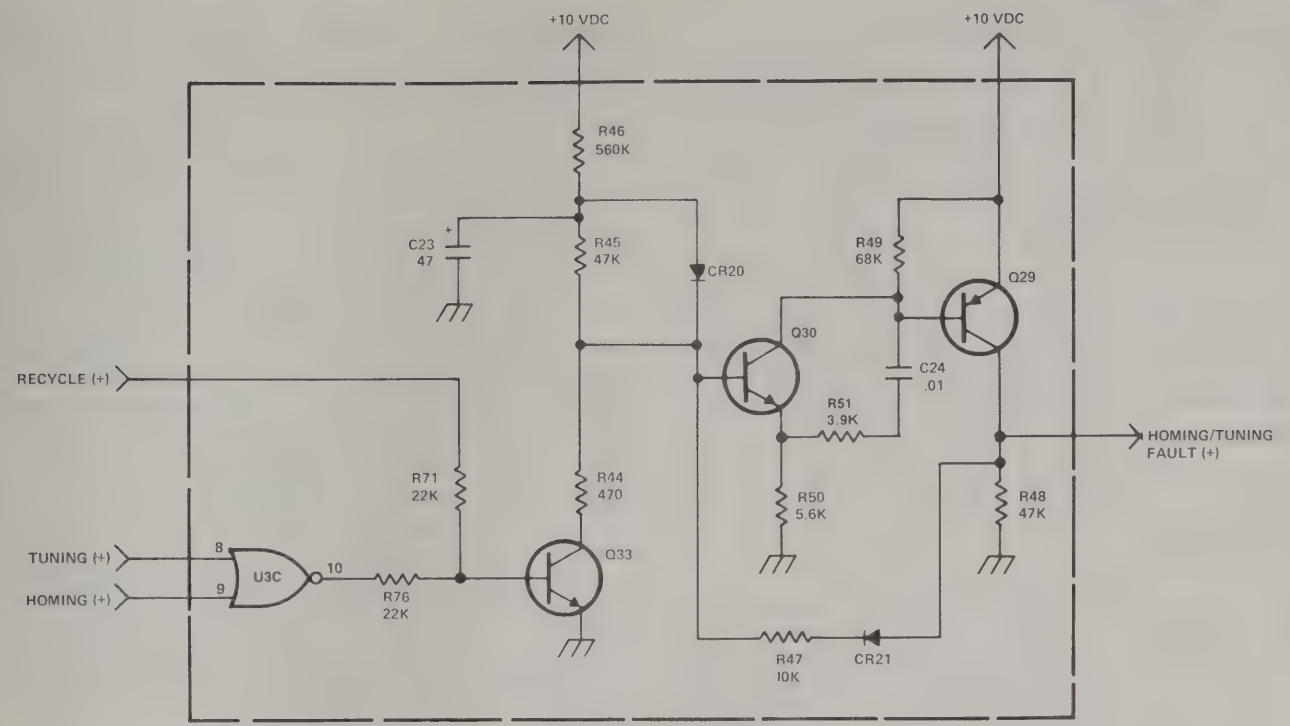


FIGURE 4-22. Timer, Fault Control.

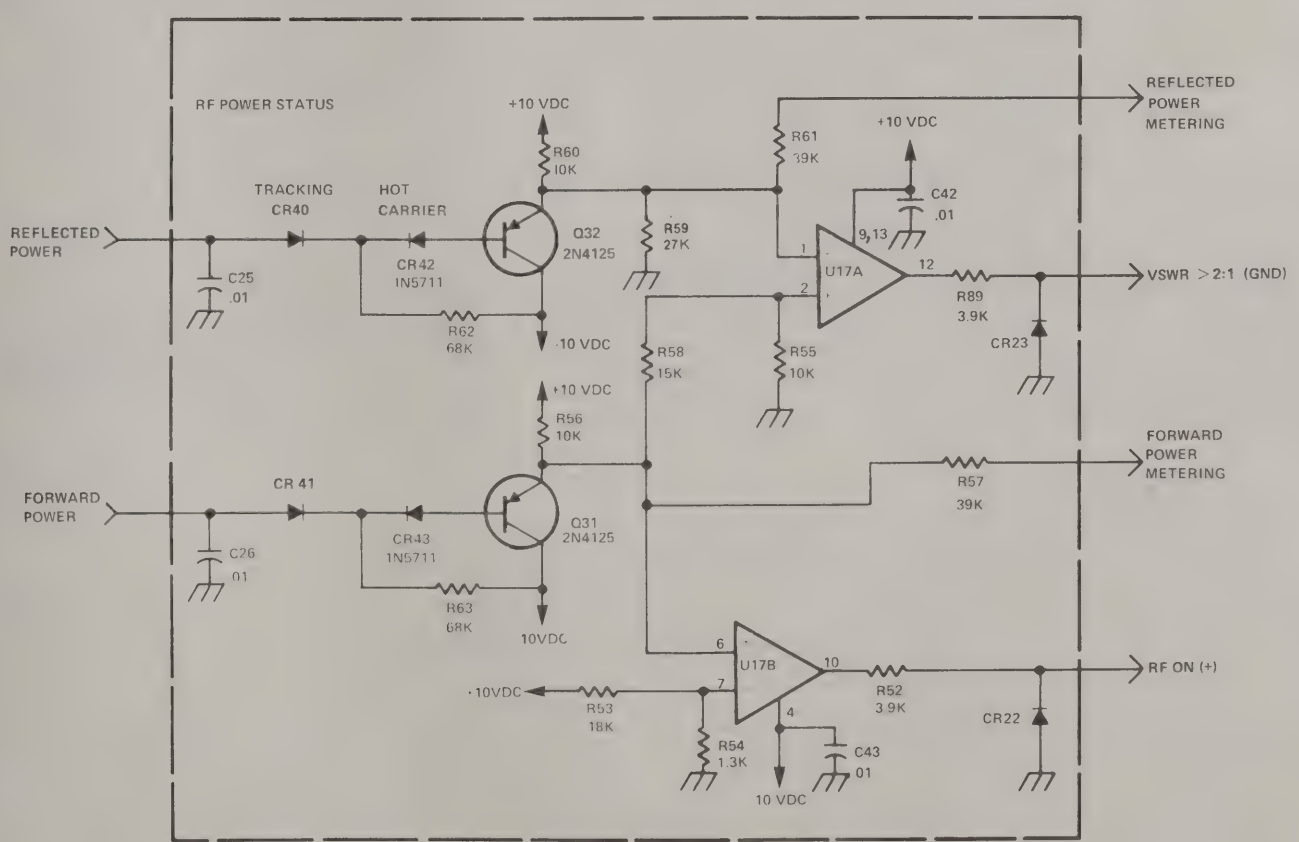


FIGURE 4-23. RF Power Status.

4.5.3.13 RF Present Logic and Control

Refer to Figure 4-24 and to the related simplified diagram on Figure 4-11. The "RF Present" (gnd) logic level is produced by anding the delayed "RF ON" (+), and the "Key" (+) logic levels. This output is used with the Sequence and Servo Enable Logic, and it is also used in combination with the VSWR > 2:1 output at the "L1 to Max Forcing" logic and at the "Fault" logic.

Combining the "Key" (+) and the "RF ON" (+) assures the various logic circuits requiring the "RF Present" (gnd) will respond only when the transmitting system is keyed. This prevents response to an unkeyed system that is susceptible to near-field interference from another close-by transmitting system.

The 75 ms timer allows time for an initially keyed transmitter carrier to stabilize before being used by the SC400 circuits.

4.5.3.14 L1-To-Max Forcing Logic and Control

Refer to Figure 4-25 and to the related simplified diagram on Figure 4-11. U6B has four inputs and functions as an AND gate in that all logic levels must be low for the output to go high. When the U6B output is high, Q40 and Q41 are turned on and place a forcing ground on the L1 Servo Control system that will force L1 to run toward the maximum inductance position.

The conditions required to generate this function will normally occur only during the initial tuning operation in the low frequency range from 1.5 MHz to approximately 3 MHz. As an example, if the servo motor for variable capacitor C1 was energized by the phase detector to drive toward maximum capacitance, and if the capacitor was already at maximum capacitance, the capacitor could not move. With these conditions a capacitive phasing signal to the coupler would be so far from the tune point that the resistance detector output would be insufficient to drive the variable inductor toward the tune point. The L1 to maximum forcing logic would sense this condition and generate an L1-to-maximum forcing ground. As variable inductor L1 is driven toward maximum, the phase detector will eventually change to indicate an inductive phasing output and the forcing ground will automatically be removed. At this point the capacitor and the inductor will be actively driven in response to signals from the appropriate detector.

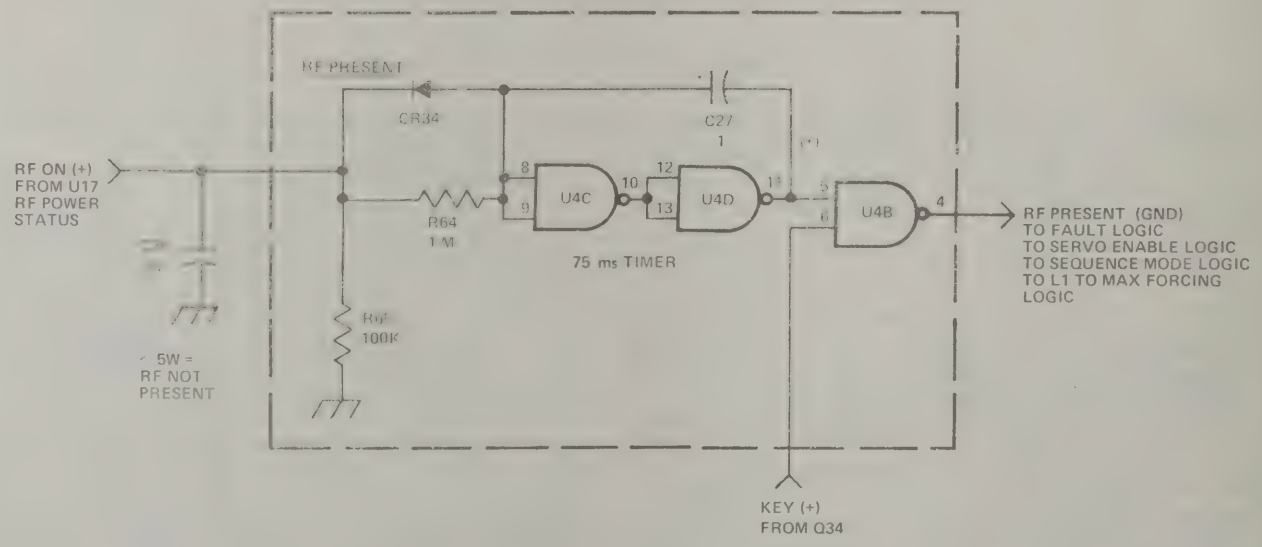


FIGURE 4-24. RF Present Logic & Control.

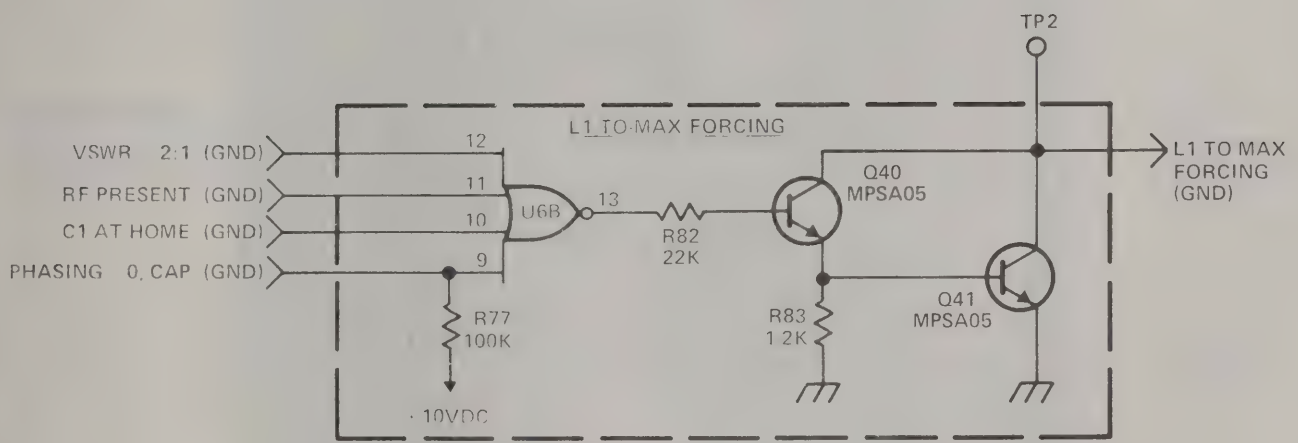


FIGURE 4-25. L1 to Max Forcing Logic & Control.

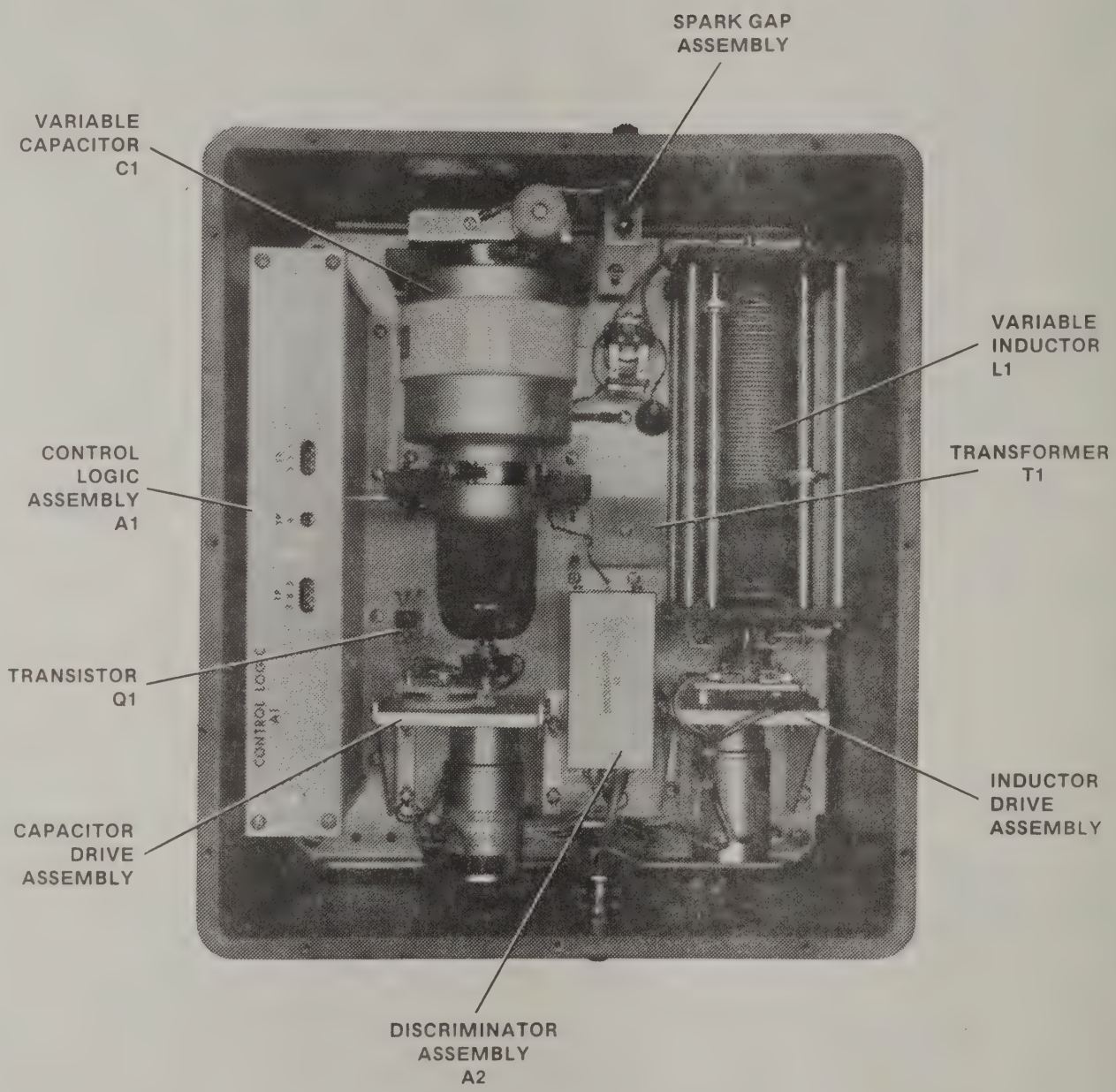


FIGURE 5-1. SC400 Major Subassemblies.

SECTION V
MAINTENANCE

5.0 GENERAL

NOTE

No field maintenance is recommended for the SC400. All maintenance should be performed in a clean shop environment.

Maintenance procedures described in this section include periodic inspection, cleaning and lubrication; trouble-shooting, repair, and alignment. Figure 5-1 identifies the major subassemblies discussed in this section.

5.1 PERIODIC MAINTENANCE

CAUTION

Lethal RF voltages can exist within the SC400 under operating conditions. Always disconnect the RF input and control cable prior to attempting any cleaning or inspection procedure.

5.1.1 Inspection

Frequency of inspection depends on environmental conditions and equipment utilization. Inspection of the SC400 should cover the following points as a minimum:

a. Check connectors for tightness.
b. Check electrical connections for tightness and evidence of arcing.
c. Check the spark gap for spacing.
d. Check L1 and C1 drive assemblies for signs of wear.
e. Check the relay for contact damage.

5.1.2 Cleaning and Lubrication

The SC400 should be cleaned as required to keep the unit free of foreign particles. The unit can be cleaned using low pressure air or with a soft cloth moistened in a mild detergent for stubborn particles. The SC400 should not require cleaning very often unless exposed to extreme environmental conditions.

CAUTION

Alcohol should be used for cleaning variable inductor L1. Commercial solvents may damage the inductor form.

5.1.2.1 Variable Inductor Lubrication

The coil windings, roller shafts, roller contacts and the spring contacts on the shafts of L1 should be cleaned with alcohol.

Lubrication points on the L1 assembly are shown in Figure 5.2. Apply a light coating of Dow Corning DC-33 silicone lubricant to the inductor turns using a soft lint-free cloth. The lubricant should be invisible to the naked eye but sufficient to make the turns feel slippery. Apply a heavier, slightly visible, coating to each of the electrical contact shafts and to the spring contact shafts. Some lubricant build-up on these surfaces after running the inductor is acceptable.

NOTE

It is not necessary to lubricate the nylon gears.

5.1.2.2 Variable Capacitor Lubrication

Lubrication of the thrust bearing assembly, capacitor drive shaft, and capacitor plunger is required at six month intervals. These points are identified in Figure 5-3.

C1 should be returned to the "Home" position by rechanneling the SC400. Remove C1 per paragraph 5.3.1.7. Unscrew and remove the capacitor drive shaft by turning in a counterclockwise direction. This allows access to the thrust bearing and the drive shaft. The blue bell-housing comes off when the drive shaft is removed. Apply a small amount of silicone grease to the threaded portion of the drive shaft and the thrust bearing. Reassemble the bearing and shaft into the bell-housing. Screw the drive shaft into the capacitor two or three turns. Firmly hold the capacitor body in one hand, and the bell-housing in the other. Pull the bell-housing axially away from the capacitor body slightly.

CAUTION

The capacitor's internal spring requires several pounds of force to expose the plunger. Do not allow the bell-housing to snap back against the capacitor body. This action could break the vacuum seals in the capacitor.

This action exposes the capacitor plunger. Apply two or three drops of silicone oil to the surface of the plunger. Slowly allow the plunger to return to the rest position. Screw the drive shaft into the capacitor body until the bell-housing just tightens. Replace the capacitor in the unit per paragraph 5.3.1.8, and adjust for proper "Home" position.

5.2 TROUBLESHOOTING

Troubleshooting the SC400 is simple and straightforward. The method used depends on whether standard trouble-shooting procedures are used, or whether a SC365 test set is available.

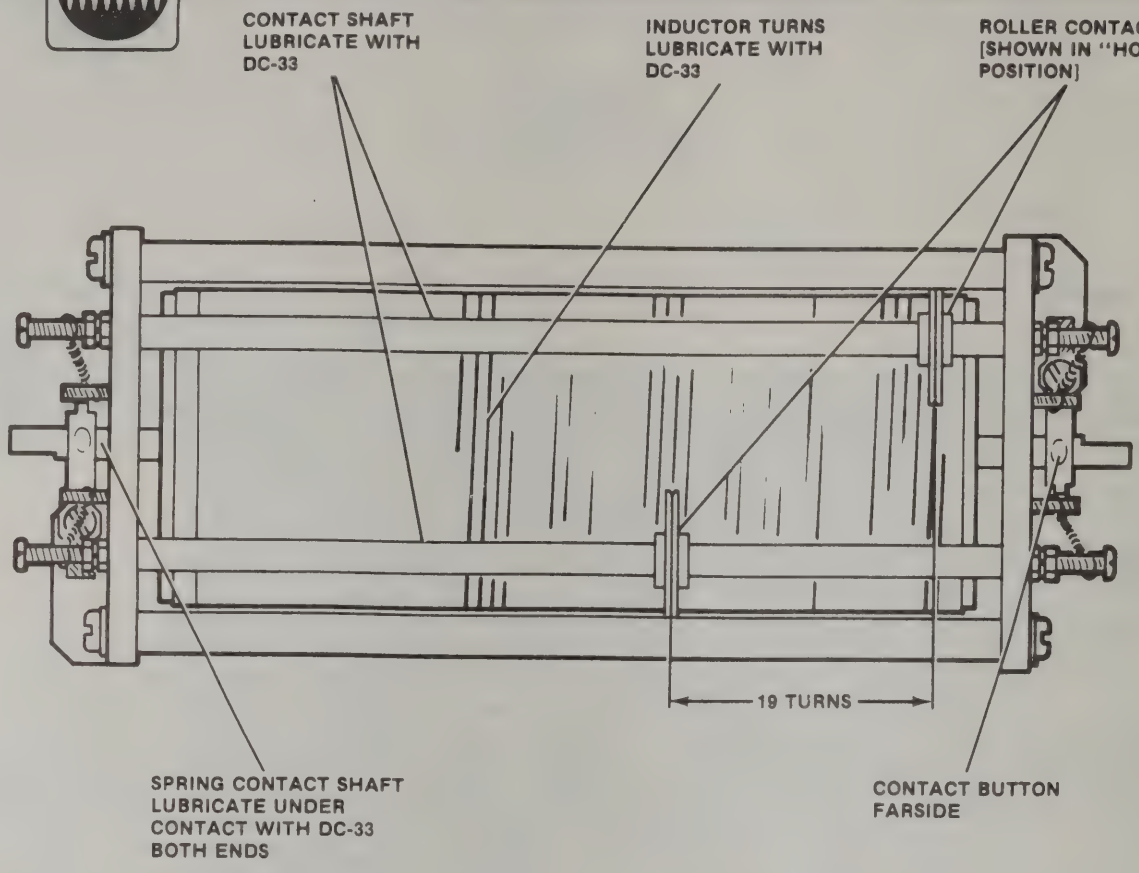


FIGURE 5-2. Variable Inductor, L1, Lubrication Points.

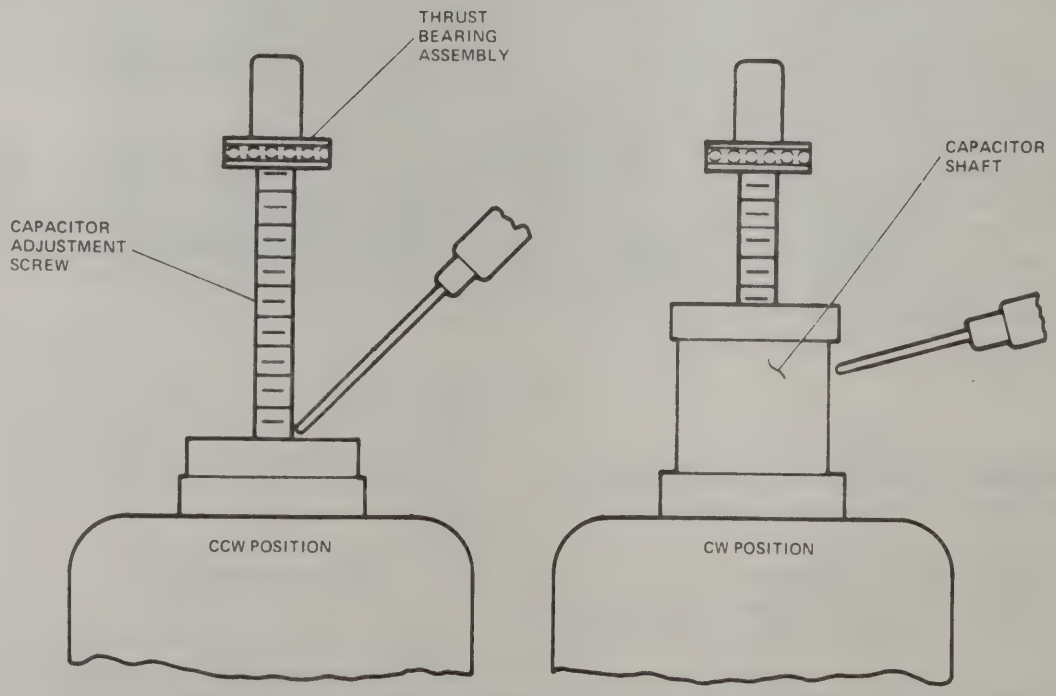


FIGURE 5-3. Variable Capacitor, C1, Lubrication Points.

5.2.1. Standard Troubleshooting Procedure

Troubleshooting the SC400 is normally accomplished by analyzing the equipment response to a given set of inputs. Figure 5-4 shows the control function sequence in the SC400 during normal operation; this information should be helpful in solving most problems encountered in the equipment.

Figure 5-5 is an assembly drawing showing component locations on the Control Logic pc board. All of the control elements in the SC400 are contained on this pc board. Figure 5-5 also shows the location of components related to the major control functions outlined with dotted lines.

For each mode of the SC400, Table 5-1 shows the normal operating voltages at each of the seven test points inside side the unit. These test points are accessible from the top of the SC400 on the Control Logic pc board without removing it from its enclosure. The test points are color coded and numbered for ease of identification.

Figures 5-6, 5-7, 5-8, 5-9, and 5-10 present schematic, functional and other related information on the integrated circuits used in the SC400. Truth tables are included to demonstrate how the "AND", "OR", and "INVERTER" functions are performed.

5.2.2 Troubleshooting Using the SC365 Test Set

Southcom's SC365 is a test set which can be purchased as an option to aid in troubleshooting the SC400. A schematic of the SC365 is shown in Figure 5-11. Use of the SC365 is explained as follows:

a. Connect the equipment as shown in Figure 5-12. If the SC106 is not available, then a separate DC supply and RF power source must be used.
b. Apply DC power by switching S1 "ON". The TUNE indicator will illuminate.
c. The coupler should home automatically. (The coupler can be homed after tuning with the fault reset/home switch, S2)
d. The coupler is ready to tune. Attach the test load and then apply 50 watts of power from the RF source; the rest is automatic.
e. After tuning is complete, the READY indicator will illuminate. At this time tune power can be removed. Test power levels of 100 watts can now be applied. The bypass logic can now be checked with S3. DO NOT APPLY POWER WHEN CHECKING BYPASS.
f. To reset a tune fault or to "Home" the tuning elements for another tuning operation, switch S2 momentarily. The TUNE indicator will illuminate when the system is ready for the tune operation.
g. To retune, repeat steps d and e.

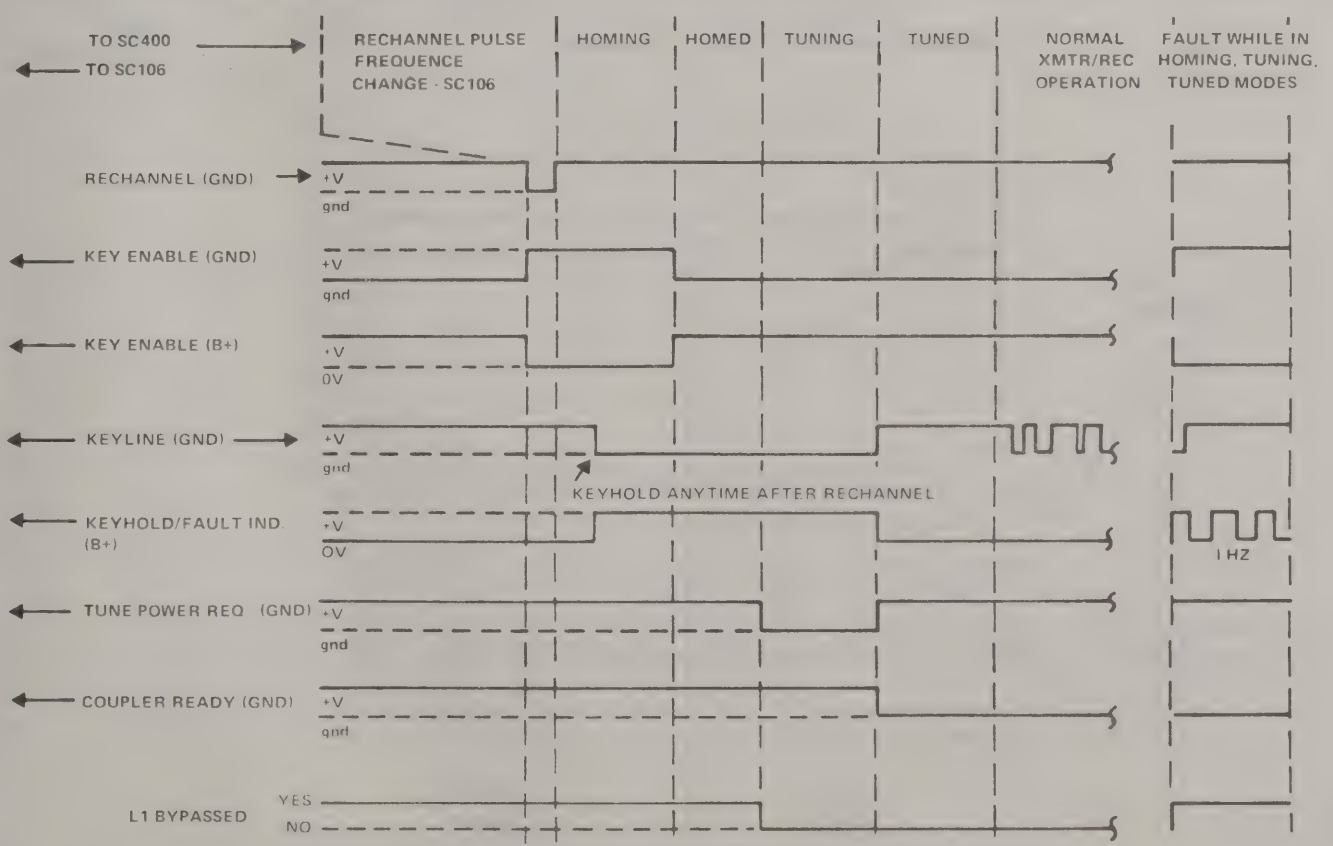


FIGURE 5-4. Control Function Levels.

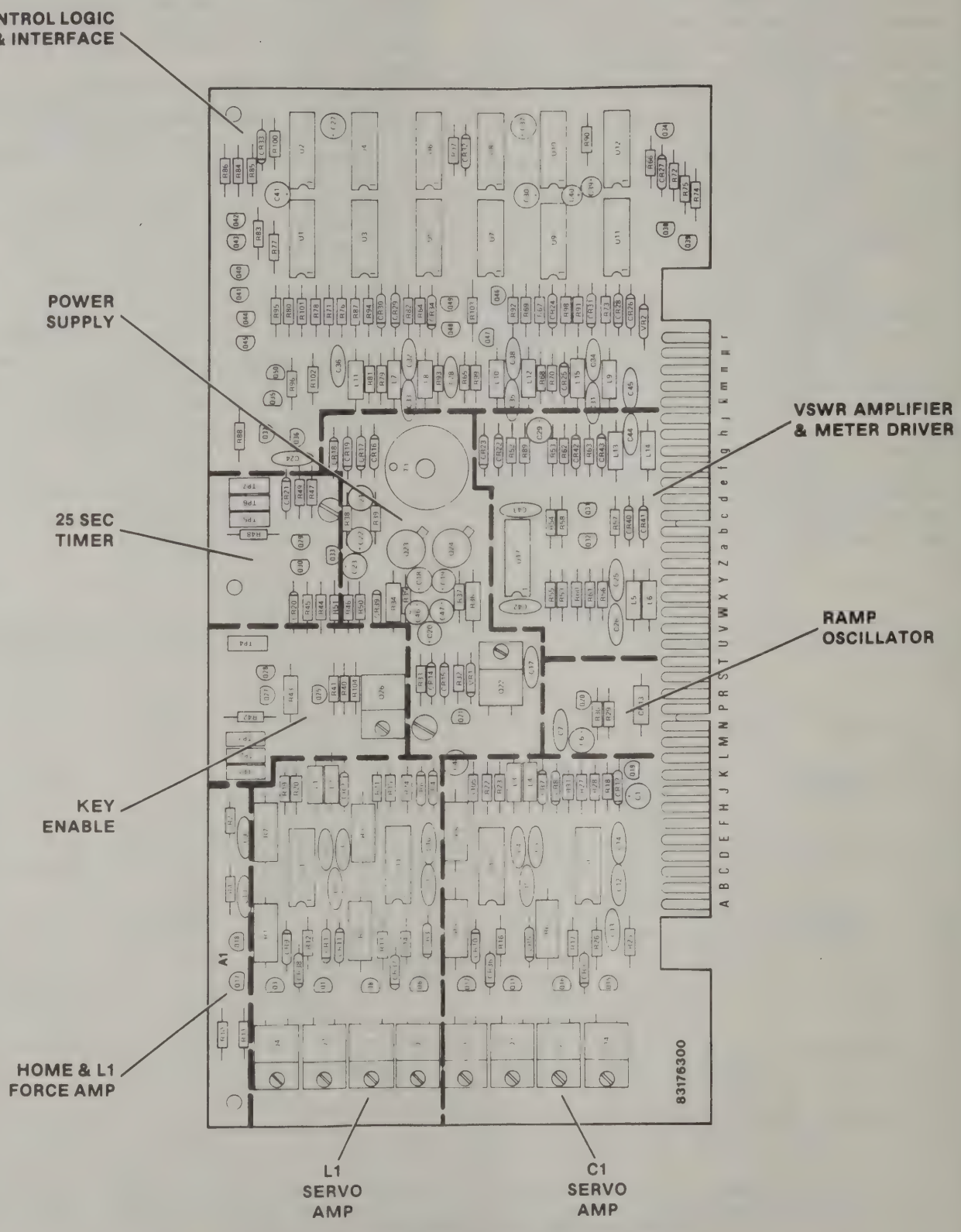
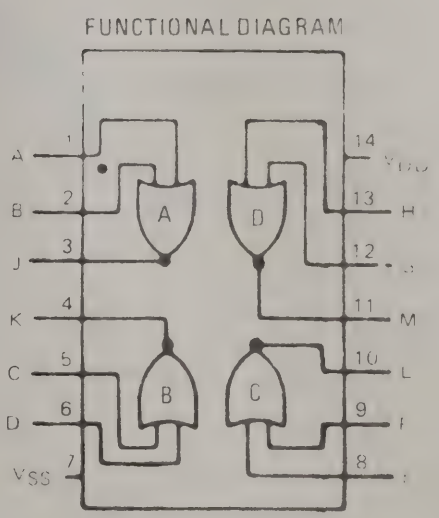
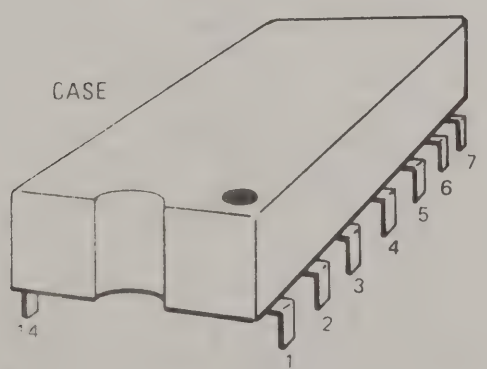


FIGURE 5-5. Control Logic PC Board Function Locations.

TABLE 5-1. Troubleshooting Chart.

CONTROL LOGIC TEST POINT	TOLERANCE	HOMING	HOMED	TUNING	TUNING FAULT	TUNED	TUNED SURVEILLANCE	TUNED FAULT
TP1-BROWN (RAMP)	RAMP FROM -0.2 TO +5.0V PERIOD 3 MS - MEASURED WITH OSCILLOSCOPE							
TP2 - RED (L1 TO MAX FORCING)	±1 VDC	24 VDC	24 VDC	0.7 VDC WHILE L1 IS FORCED	24 VDC	24 VDC	24 VDC	24 VDC
TP3 - ORANGE (REGULATED B+)	±1 VDC	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC
TP4 - YELLOW (-10 VDC)	±1 VDC	-10 VDC	-10 VDC	-10 VDC	-10 VDC	-10 VDC	-10 VDC	-10 VDC
TP5 - GREEN (VSWR > 2:1)	±0.5 VDC	+8.5 VDC	+8.5 VDC	-0.7 VDC WHILE VSWR>2:1	+8.5 VDC	+8.5 VDC	+8.5 VDC	+8.5 VDC
TP6 - BLUE (SERVO ENABLE)	±2 VDC	22 VDC	0.7 VDC	22 VDC	0.7 VDC	12 VDC	RF ON 12 VDC RF OFF 0.7 VDC	0.7 VDC
TP7 - VIOLET (+10 VDC)	±1 VDC	+10 VDC	+10 VDC	+10 VDC	+10 VDC	+10 VDC	+10 VDC	+10 VDC





TRUTH TABLE

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

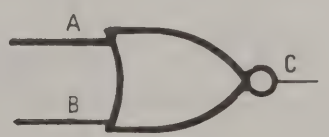
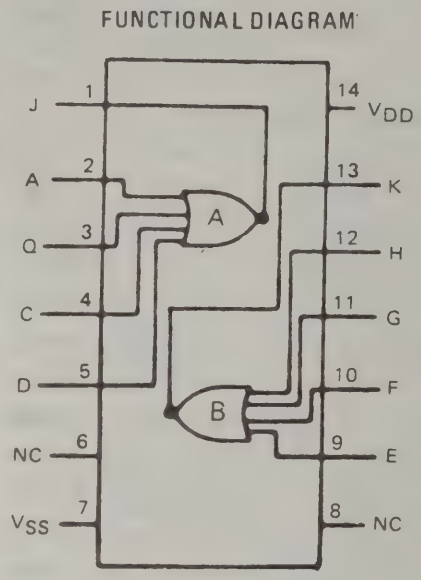


FIGURE 5-6. CD4001 Quad 2 Input NOR Gate, cos/mos Positive Logic.



TRUTH TABLE

A	B	C	D	E
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

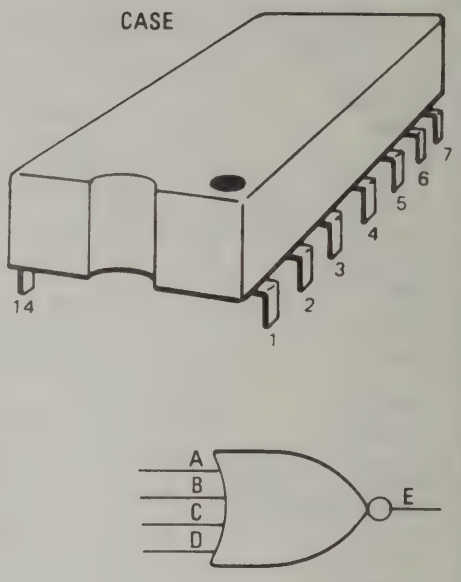
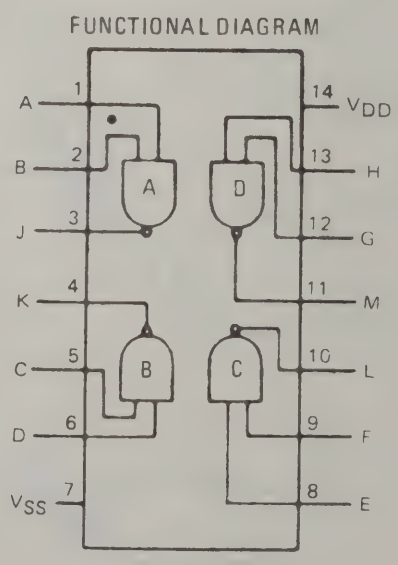
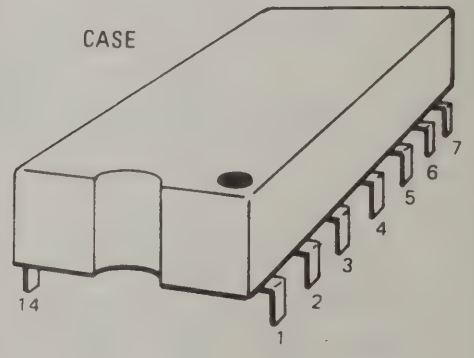


FIGURE 5-7. CD4002 Dual 4 Input NOR gate.





TRUTH TABLE

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

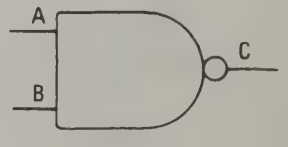
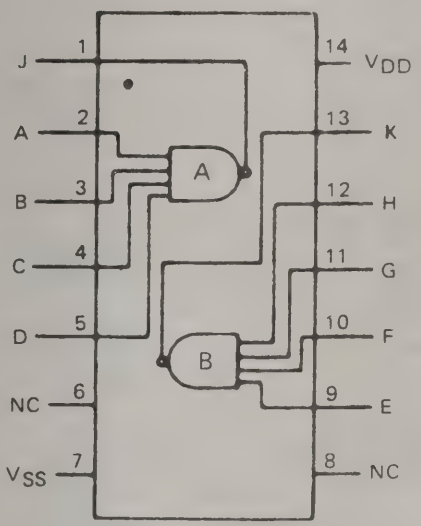


FIGURE 5-8. CD4011 Quad 2 Input nand Gate, cos/mos Positive Logic.

FUNCTIONAL DIAGRAM



TRUTH TABLE

A	B	C	D	E
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

CASE

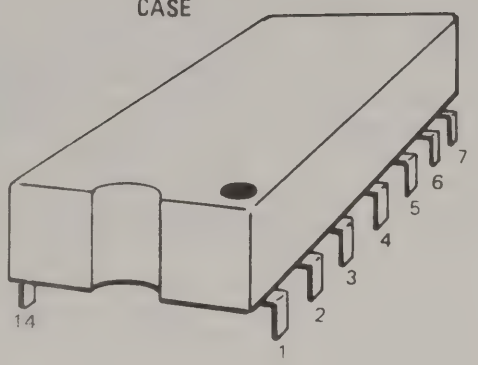
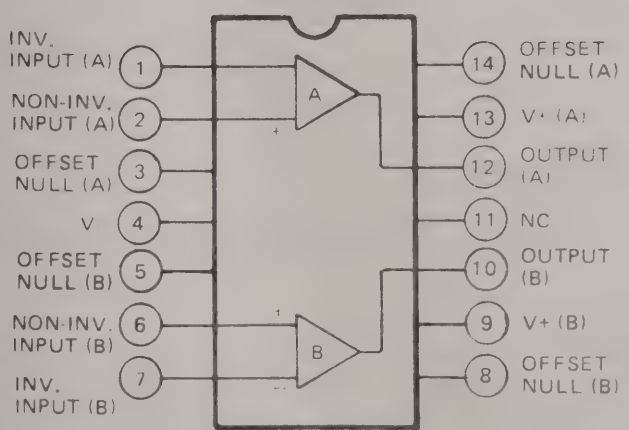
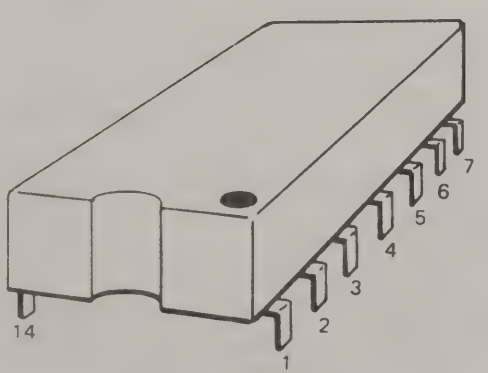


FIGURE 5-9. CD4012 Dual 4 Input NAND Gate.



TOP VIEW



CASE

FIGURE 5-10. CA747 Dual Operational Amplifier.

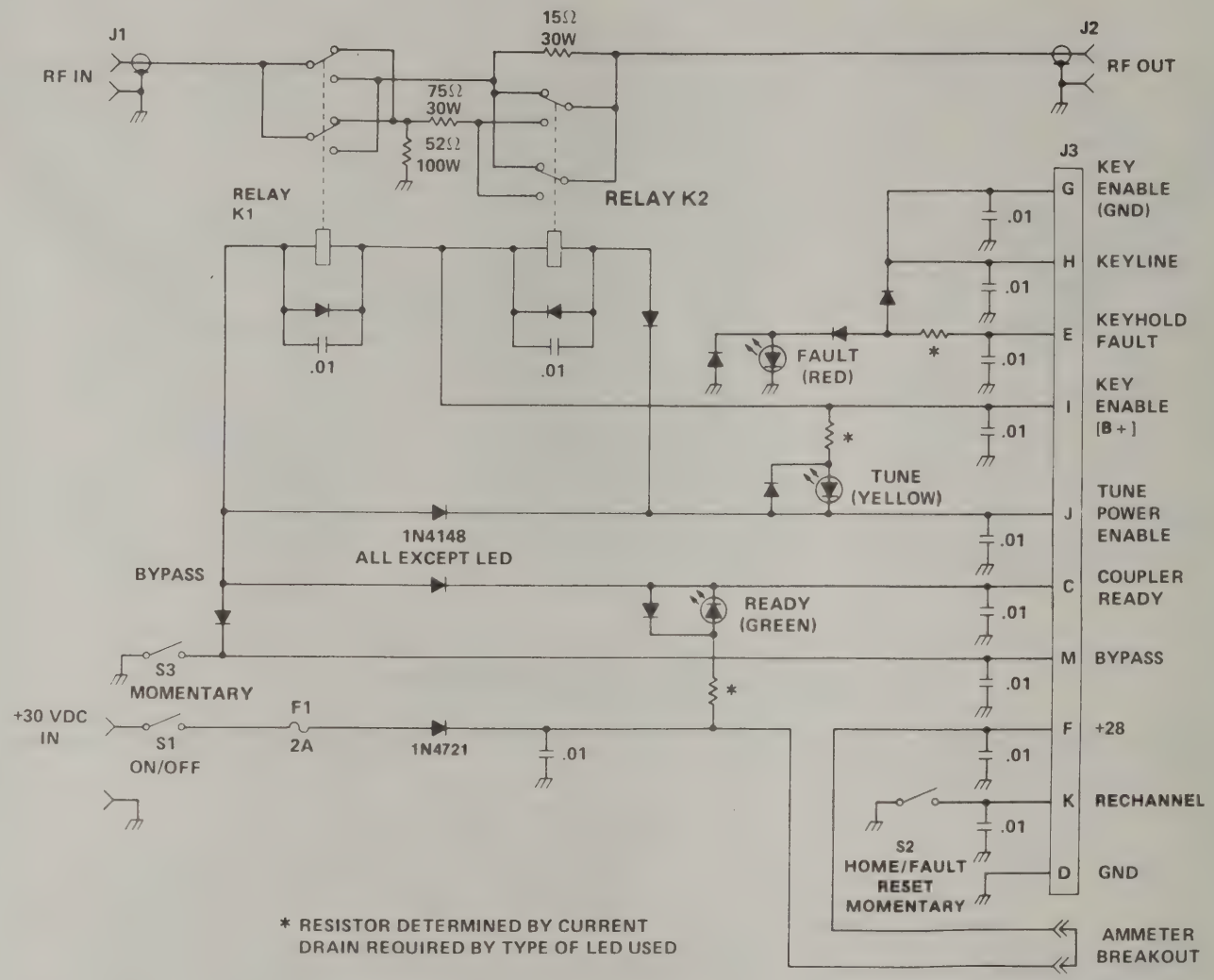


FIGURE 5-11. SC365 Test Set Schematic.

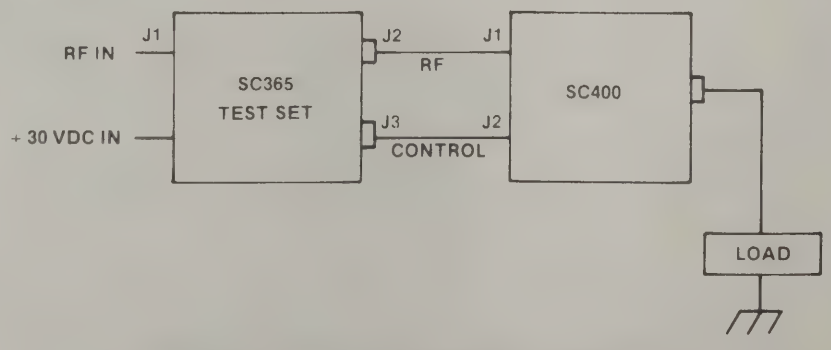


FIGURE 5-12. Use of SC365 with SC400.

5.3 DISASSEMBLY/REASSEMBLY PROCEDURES

The following table provides torque requirements for various screws referred to in the procedures.

Screw Size	Required Torque (in lbs.)
4-40	5 ±5%
6-32	9 ±5%
8-32	19 ±5%
10-24	31 ±5%
10-32	30 ±5%
5/16-18	125 ±5%

5.3.1 SC400 Disassembly/Reassembly

Detailed procedures are presented for the following assemblies:

a. Main Chassis
b. Discriminator
c. Variable Inductor
d. Inductor Drive
e. Variable Capacitor
f. Capacitor Drive
g. EMI Filter
h. Regulator Transistor (Q1)

5.3.1.1 Main Chassis Removal

Removal of the main chassis is not normally necessary for routine maintenance. When necessary, the following procedure should be followed:

a. Remove the 12 number 10 screws holding the cover to the case.
b. Remove the nut securing the control cable connector to the case. Push the connector back through the case, bending the ground strap. Leave the connector supported by the ground strap.
c. Remove nut securing RF input cable (coax) connector J1 to case: Pull connector through case.
d. Disassemble and remove antenna input stud. Loosen ground stud.
e. Remove screw from ground bracket at chassis.
f. Remove the remaining 6 screws securing the chassis to the case.
g. Remove chassis by lifting end opposite ground bracket. Leave ground bracket in place.
h. To reinstall chassis reverse the above procedures.
i. Check the spark gap assembly for proper adjustment per paragraph 5.4.4.

NOTE

The cover gasket should be inspected and replaced as required. If the original gasket must be replaced, the gasket material must be completely removed.

j. Replace cover and gasket and tighten screws.

NOTE

Overtightening may damage the gasket or cover.

5.3.1.2 Discriminator Assembly A2 Removal

Refer to Figure 5-13 for the following procedure:

a. Remove SC400 top cover.
b. Mark and tag wires connected to Discriminator Assembly, unsolder and remove.
c. Disconnect nut securing RF input cable (coax) connector J1 to case. Pull connector through case.
d. Remove four (4) screws securing Discriminator Assembly to chassis.
e. Lift assembly out from case.
f. Remove four (4) screws securing cover to assembly, and remove cover.
g. The Resistance Detector and Phase Detector PC Boards may now be removed. Tag and remove wires connected to the discriminator chassis, remove the mounting screws and remove from the assembly.
h. To reassemble Discriminator Assembly reverse the above procedure. Adjust the assembly (per paragraph 5.4.1) prior to installing it on the chassis.

5.3.1.3 Variable Inductor L1 Removal

Refer to Figures 5-1 and 5-14 for the following procedures.

NOTE

Remove the chassis assembly from the case per paragraph 5.3.1.1 prior to disassembling this unit.

a. Unsnap the shaft coupling between motor and L1.
b. Locate wires connected between K1 and L1. Disconnect wires at K1 by unsoldering.
c. Remove the four (4) screws securing the inductor assembly L1 to the chassis. Remove the inductor assembly.

5.3.1.4 Variable Inductor L1 Reassembly

Refer to Figures 5-1 and 5-14 for the following procedures:

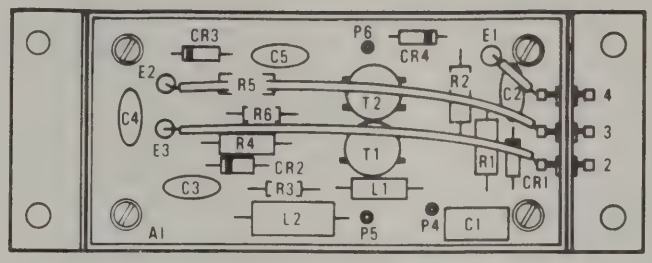
a. Locate L1 on chassis and snap shaft coupling together.
b. Install four (4) screws securing inductor to chassis. Do not tighten. Manually turn inductor to check alignment with motor. Tighten screws.
c. Connect output wires between variable inductor and K1.
d. Adjust rollers for 19 turns spacing.
e. Manually rotate inductor to its maximum cw position (facing drive shaft). This positions the drive assembly to minimum inductance.
f. Make final adjustments per paragraph 5.4.2.

5.3.1.5 Inductor Drive Assembly, A3, Removal and Reassembly

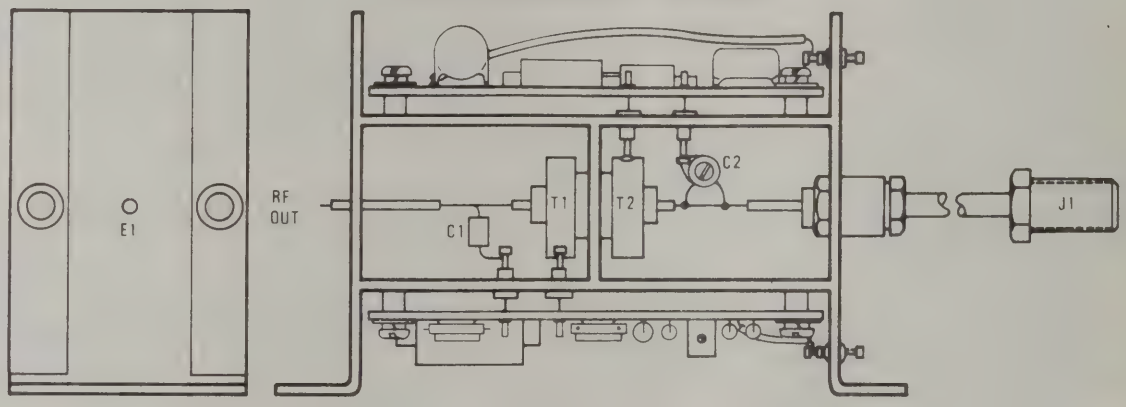
Refer to Figure 5-14 for the following procedures:

a. Remove the chassis assembly from the case per paragraph 5.3.1.1.
b. Unsnap shaft coupling.
c. Mark and tag the connecting wires to the chassis, unsolder at microswitches and remove.
d. Remove four (4) screws securing the A3 Drive Assembly to the chassis. Remove drive assembly.

A2A1
RESISTANCE
DETECTOR



A2 DISCRIMINATOR ASSEMBLY



A2A2
PHASE
DETECTOR

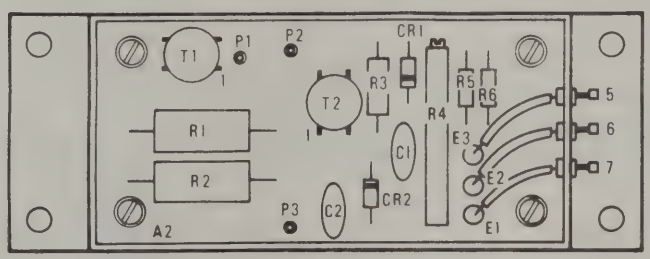


FIGURE 5-13. Discriminator Assembly.

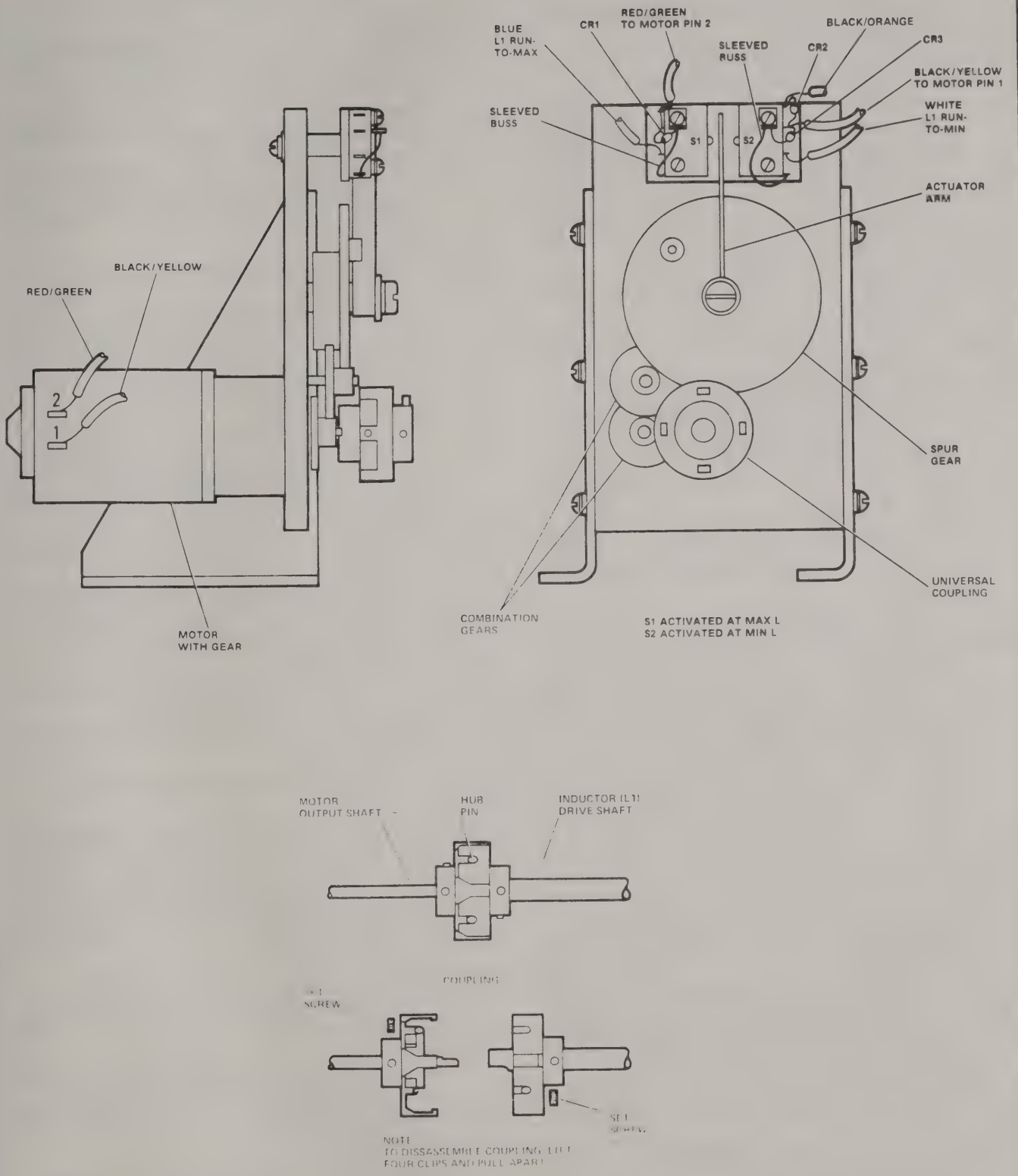


FIGURE 5-14. Inductor Drive Assembly.

e. For reassembly, install coupling in the same position on motor shaft and tighten set screws.
g. Snap shaft coupling and install screws removed in step d. Do not tighten.
h. Resolder wires removed in step c.
i. Align variable inductor per paragraph 5.3.1.4.
j. Tighten set screws and check position of coupling hub pins as follows: Side-to-side and top-to-bottom hub pin alignment should be within 1/32 inch (0.08 cm) of being flush. If not within this tolerance, loosen the four (4) screws securing the inductor drive assembly and reposition such that alignment within tolerance is achieved. This unit is also secured with four (4) screws.
k. Tighten all hardware and make final adjustments per paragraph 5.4.2.

5.3.1.6 Variable Inductor End Stop Sensing Switch Replacement

Refer to Figure 5-14 for the following procedures:
a. Mark, tag and unsolder wires to applicable switch.
b. Remove screws securing applicable switch to mounting plate. Remove switch.
c. Position new switch on mounting plate, insert screws and tighten.
d. Connect wires to switch as marked, and solder.
e. Adjustment should not be necessary unless other parts have been moved. Adjust per paragraph 5.4.2 if necessary.

5.3.1.7 Variable Capacitor C1 Removal

Refer to Figures 5-1 and 5-15 for the following procedures:
a. Remove chassis from case per paragraph 5.3.1.1.
b. Separate the coupling halves as shown in Figure 5-15 and loosen (but do not remove) the screw in capacitor clamp on antenna end of C1.
c. Remove two (2) screws and nuts securing the capacitor clamp nearest the capacitor shaft. Carefully pull T1 output wire away from support. If necessary, loosen coupling half.
d. Tilting capacitor slightly, pull it out from the antenna end clamp.
e. Remove capacitor from the unit, taking care not to damage ceramic envelope and observe position.
f. Loosen (but do not remove) screw in the capacitor clamp and remove clamp.

5.3.1.8 Variable Capacitor C1 Reassembly

Refer to Figures 5-1 and 5-15 for the following procedures:
a. Place clamp over drive end of capacitor. Tighten screw finger tight.
b. Slide coupling half onto capacitor shaft. Tighten one of the set screws so that coupling can be used as a knob.
c. Turn capacitor shaft ccw until lead screw housing becomes loose.
d. Turn capacitor shaft cw until housing just becomes tight. This places the capacitor in "Home" or maximum capacitance position.
e. Tilt capacitor slightly and slide into antenna end clamp. Position capacitor with metal nipple off to one side.
f. Position drive end capacitor clamp on capacitor support. Replace two (2) screws and nuts. Do not tighten. Ensure that T1 output wire is secured to clamp by adjacent screw.
g. Align drive assembly coupling half on motor shaft.
h. Snap coupling halves together.
i. Side-to-side and top-to-bottom coupling hub pin alignment should be within 1/32 inch (0.08 cm) of being flush. If not within this tolerance, continue as follows.
ii. Loosen four (4) screws securing the capacitor drive assembly.
iii. If horizontal misalignment cannot be corrected, the capacitor mounting bracket, secured by eight (8) screws, can be loosened along with the two (2) brass screws securing capacitor brackets to printed circuit board case.
iv. If vertical misalignment cannot be corrected, loosen the capacitor end clamp (near antenna), and the two (2) brass screws holding the front capacitor clamp to the mounting bracket. Capacitor can be raised or lowered slightly to achieve alignment.
v. Tighten all hardware, recheck alignment and reinstall in case.

5.3.1.9 Variable Capacitor Drive Assembly A4 Removal

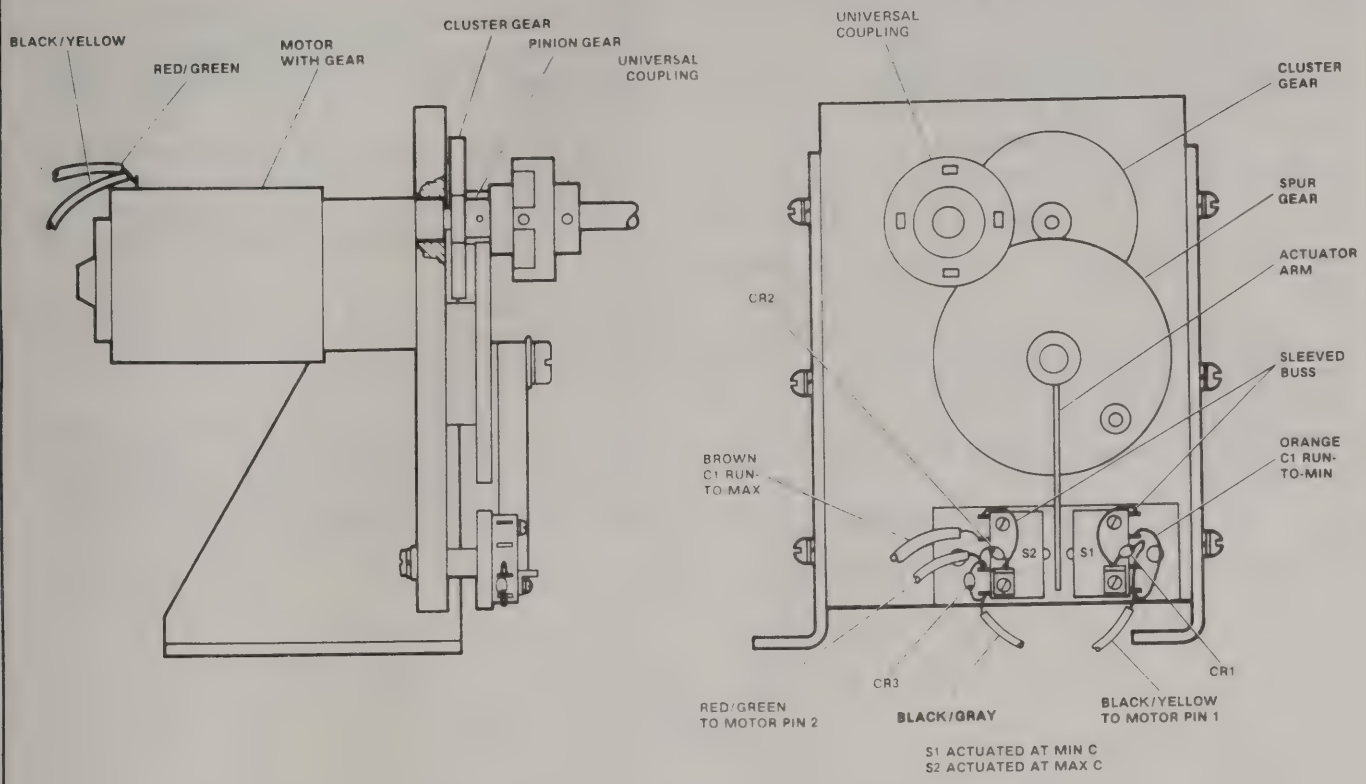
Refer to Figure 5-15 for the following procedures:
a. Remove chassis from case per paragraph 5.3.1.1.
b. Unsnap coupling.
c. Mark and tag wires from motor and switches, unsolder wires at switches and motor.
d. Remove four (4) screws securing drive assembly.
e. Remove assembly.

5.3.1.10 Variable Capacitor Drive Assembly A4 Reassembly

Refer to Figure 5-14 for the following procedure. To reassemble Variable Capacitor Drive Assembly A4, refer to applicable steps in paragraphs 5.3.1.8 and 5.3.1.9, check position of coupling pins per paragraph 5.3.1.8h.

5.3.1.11 Variable Capacitor End Stop Sensing Switch Replacement

Refer to Figure 5-15 for the following procedures:
a. Remove chassis from case per paragraph 5.3.1.1, and mark, tag and unsolder wires to switch assembly.
b. Remove screws securing applicable switch assembly to mounting plate. Remove switch assembly.
c. Position new switch on mounting plate, insert screws and tighten.
d. Reinstall switch assembly.
e. Connect wires to switches as marked and solder.



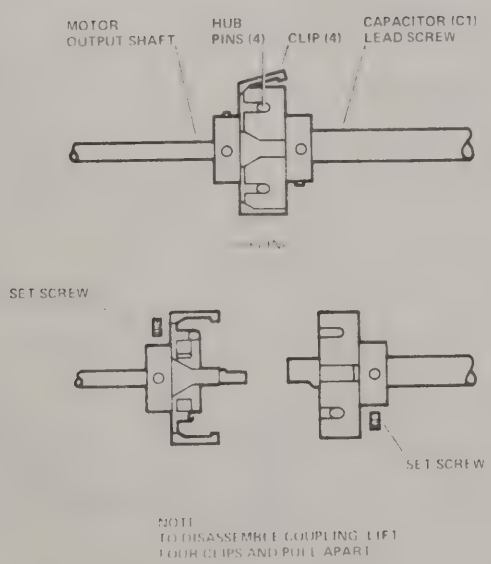


FIGURE 5-15. Capacitor Drive Assembly.

5.3.1.12 EMI Filter Assembly A5 Removal

Refer to applicable directions in paragraph 5.3.1.1 for removal of EMI Filter Assembly A5.

a. Mark and tag wires. Unsolder wires.
b. Remove screw securing ground strap
c. To reinstall, reverse steps a and b.

5.3.1.13 Transistor Q1 Replacement

Refer to Figure 6-16 for the following procedure.

NOTE

Chassis Assembly must be removed per paragraph 5.3.1.1.

a. Remove screw, screw insulator, flat washer, lock washer, and nut securing Q1 to chassis.
b. Unsolder leads from Q1 to chassis terminals.
c. Lift Q1 out from unit.
d. Position new Q1 on chassis, and reverse steps a through c.
e. Reassembly chassis in case per paragraph 5.3.1.1.

5.4 ADUSTMENTS

5.4.1 Discriminator Assembly A2 Adjustment

Use the following procedure after discriminator repairs or when testing indicates that the assembly requires adjustment.

The Discriminator Assembly must be removed from the unit per paragraph 5.3.1.2 for adjustment. Clamp or attach the assembly to an aluminum plate to enclose the open bottom for proper shielding and ground current distribution.

Solder the center conductor of the Discriminator Test Cable (see paragraph 5.5) to discriminator RF output E1, and connect the shield to the nearest ground point on the discriminator chassis.

Connect the other end of the cable to a 50 ohm, 100 watt dummy load. Connect an RF output cable from a transmitter to discriminator RF input at J1. Terminate E7 through a 10K resistor to ground as shown in Figure 5-17.

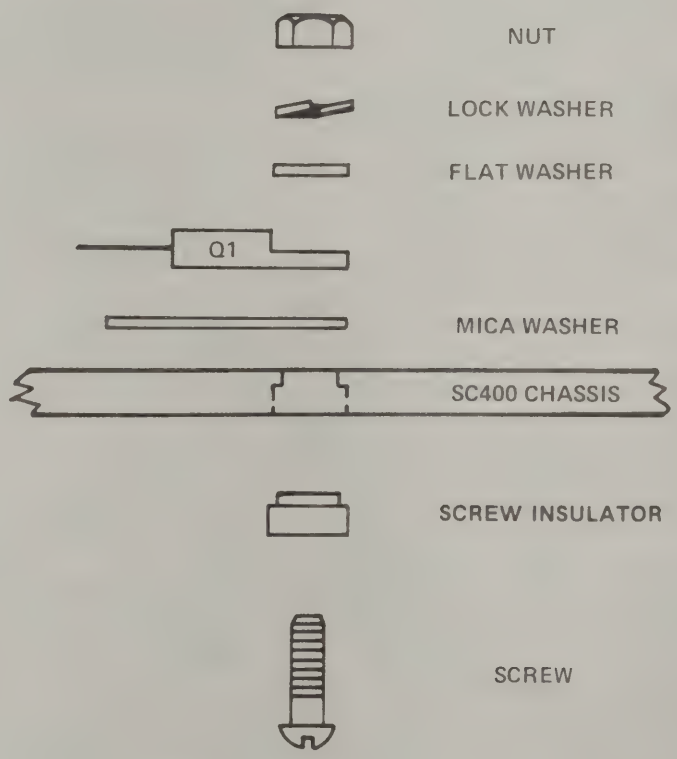
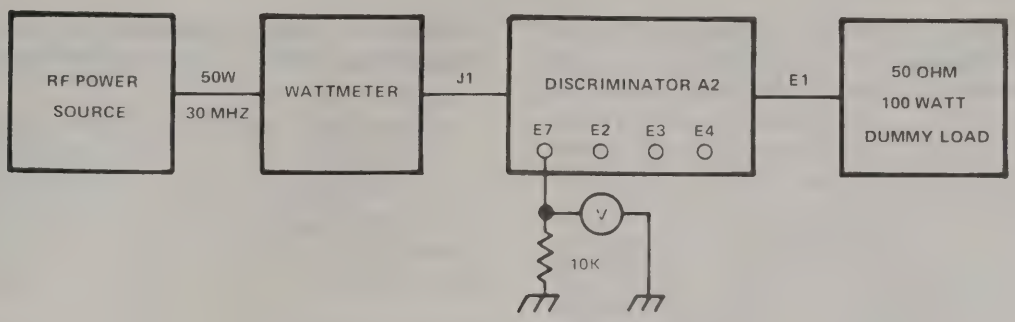
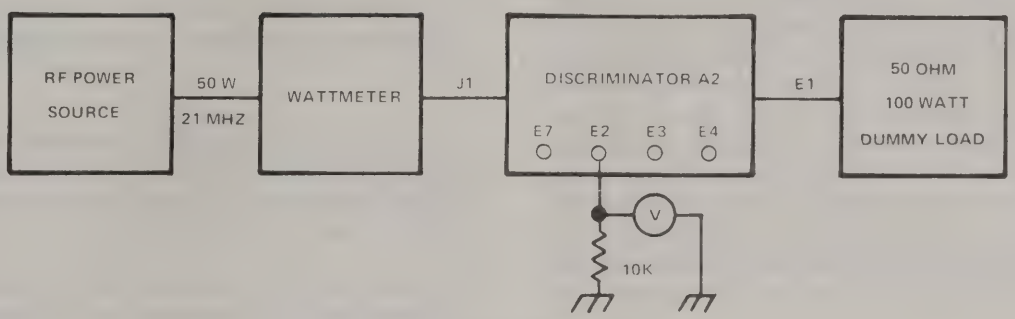


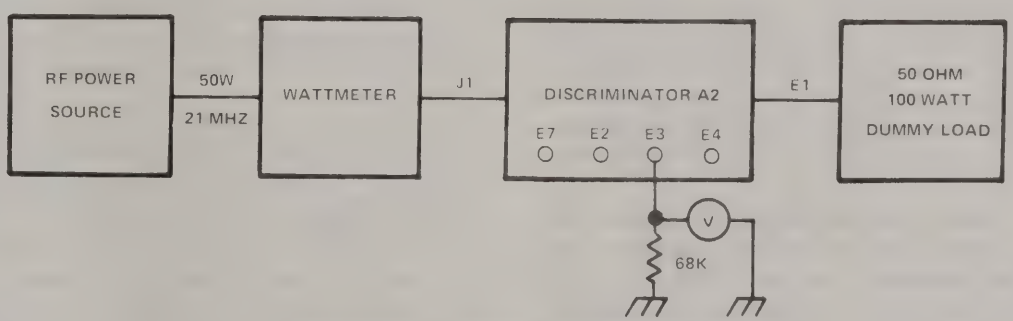
FIGURE 5-16. Transistor Q1 Assembly.



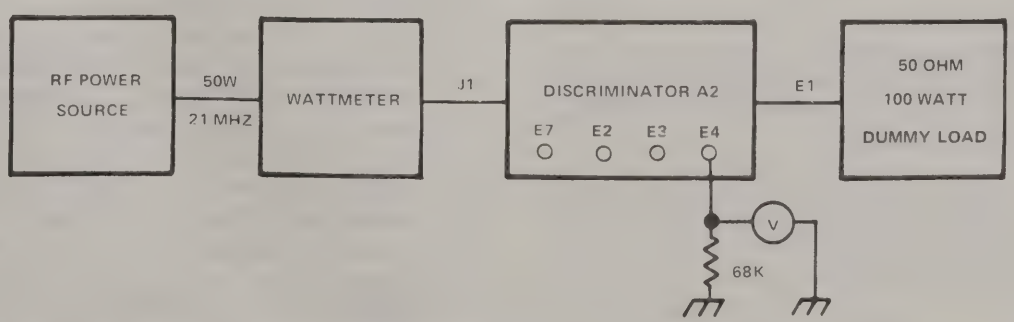
a. R4 ADJUSTMENT



b. C2 ADJUSTMENT



c. REFLECTED POWER MEASUREMENT



d. FORWARD POWER MEASUREMENT

FIGURE 5-17. Discriminator Alignment.

Connect a wattmeter (Bird Model 43, or equivalent) in line with the discriminator RF input. Connect a high impedance voltmeter between A2E7 and ground (see Figure 5-17). Set the transmitter frequency at 29.999 MHz. Key the transmitter and adjust input level to 50 watts (nominal). Adjust A2A2R4 so that the voltage on the voltmeter is 0 ± 10 millivolts.

Disconnect voltmeter and resistor from A2E7 and connect to A2E2 (see Figure 5-17). Set transmitter frequency to 21 MHz and input level to 50 watts (nominal). Adjust A2A3C2 so that the voltage indicated on the voltmeter is 0 ± 10 millivolts. Disconnect voltmeter and resistor from A2E2. Connect voltmeter and 68K resistor between A2E3 and ground (see Figure 5-17). Reflected power voltage indicated on the voltmeter should not exceed +200 millivolts maximum. Disconnect voltmeter and resistor from A2E3 and connect to A2E4 (see Figure 5-17). Forward power voltage indicated on the voltmeter should be between 2.0 and 2.5 VDC. If a high impedance voltmeter is not available use a voltmeter with a known input resistance such as 20K ohms per volt. Allow for a lower measured voltage due to the loading of the voltmeter. De-energize the transmitter and disconnect adjustment setup. Reinstall discriminator assembly in unit per paragraph 5.3.1.2.

5.4.2 Variable Inductor L1 Adjustment

Pre-position variable inductor L1 per paragraph 5.3.1.4 or drive assembly per paragraph 5.3.1.5. Loosen the adjusting screws securing the end stop sensing switch mounting bracket to motor mounting plate (see Figure 5-14). The switch mounting bracket screw holes are elongated to allow switch position adjustment. Position the switch mounting bracket in the center of its adjustment range. Tighten the adjusting screws to maintain switch position.

a. Remove Control Logic PC Board A1 by removing four (4) screws that secure the PC Board assembly in housing. Lift assembly clear and set aside.
b. Install card extender in place of Control Logic PC Board and note positions of pins B and E on exposed portion of extender card.

NOTE

Maintenance Repair Kit, P/N 992262 contains a card extender that is recommended for this procedure. If not available, the control voltage can be connected to the end stop switches (wires shown in Figure 5-14) after removing the Control Logic pc board A1.

c. Connect negative terminal of an external 0 to 24 VDC power supply capable of delivering 2 amps to chassis ground on SC400.

NOTE

The power supply would normally be set to +24 VDC, however, for initial settings, +12 VDC should be used to reduce motor speed to a level that is easier to control and thus prevent possible gear damage because of over travel.

d. Install two test leads on the power supply to make connections to the card extender. Test lead connections will result in motor travel as follows:

RUN TOWARD MINIMUM INDUCTANCE	+ LEAD TO PIN B AND − LEAD TO PIN E
RUN TOWARD MAXIMUM INDUCTANCE	+LEAD TO PIN E AND −LEAD TO PIN B

e. Connect the test leads to run the coil toward minimum inductance (+ to B and −to E).

NOTE

If the drive assembly is already at minimum, reverse leads to run coil out of minimum and then reverse leads and run back into minimum. this insures that motor over travel is incluced in the adjustment.

f. Manually turn the coil away from minimum inductance, if necessary, to place the coil shaft "flat" under the nearest set screw.
g. Run the coil assembly away from minimum to the approximate mid-point of the coil.
h. With the power supply set a +12 VDC, run the inductor to minimum. Microswitch A4A1S1 should stop the drive such that the coil is within ¼ to ½ turn of the minimum inductance mechanical end stop.
i. Adjust the power supply for +24 VDC. Run the inductor several turns away from minimum and then drive the inductor into minimum several times at this speed to assure that A4A1S1 is adjusted such that the coil stops within 1/16 to 1/8 of a turn of the end stop. Adjust A4A1S1 if necessary.
j. Run the coil to maximum. The roller nearest the antenna terminal should be within the last ½ turn of the 40 silver plated turns of the coil.
k. Check position of coupling pins per paragraph 5.3.1.8h.
l. The minimum voltage necessary to run the coil smoothly, is, in part, a function of the hub pin positioning. Run the coil to maximum and back to minimum by starting with zero volts on the external power supply and varying the voltage until the coil just starts to run smoothly. The voltage necessary to run the coil smoothly in either direction should not exceed 9 volts. Check for other problems that could cause motor loading if this value is exceeded.

NOTE

A commercial locking compound such as "Loctite" grade C or D should be applied to all set screws, especially in high vibration environments.

5.4.3 Variable Capacitor C1 Adjustment

Pre-position C1 per paragraph 5.3.1.8 or drive assembly per paragraph 5.3.1.10. Remove Control Logic pc board A1 from housing by removing four (4) screws. Lift assembly clear and set aside.

a. Insert card extender in Control Logic pc board connector at base of housing and note position of pins H and F on exposed portion of extender card.

NOTE

Maintenance Repair Kit, P/N 992262 contains a card extender that is recommended for this procedure.

b. Connect ground terminal of an external 0 to 24 VDC power supply capable of delivering 2 amps to chassis ground on SC400.

NOTE

The power supply is nominally set to +24 VDC, however, +12 VDC is used to check initial settings to reduce motor speeds and prevent possible damage.

c. Install two test leads on the power supply. Test lead connections to card extender will result in motor travel as follows:

RUN TOWARD MINIMUM CAPACITANCE	+LEAD TO PIN H AND −LEAD TO PIN F
RUN TOWARD MAXIMUM CAPACITANCE	+LEAD TO PIN F AND −LEAD TO PIN H

d. Loosen set screws on capacitor coupling.

e. Connect power supply leads for capacitor, "run to maximum", (+ lead to pin F and − lead to pin H).

f. Run the capacitor drive assembly to maximum.

NOTE

If the drive assembly was already at maximum run it off maximum and then back to maximum to assure that the motor over travel is included in the adjustment.

g. Adjust the coupling so that one of the two set screws is on the motor shaft flat. Manually turn the capacitor clockwise, if necessary, to place the capacitor shaft flat under a set screw. No more than ¼ turn should be necessary.

h. Adjust the coupling back and forth axially to center over both shafts.

CAUTION

Do not allow either shaft to protrude into the coupling past the collar. This will cause short circuits and mechanical interference during tuning.

Tighten all set screws. A commercial locking compound, such as "Loctite" grade C or D, should be applied to set screws to prevent loosening in high vibration environments.

i. Run the drive toward minimum capacitance. Minimum end stop sensing switch A4A1S1 should stop the capacitor before it runs into mechanical end stops built into the capacitor.

j. Run drive toward maximum capacitance. Maximum end stop sensing switch A4A1S2 should stop capacitor travel at mechanical limits without allowing the capacitor bell-housing to loosen.

NOTE

There are no adjustments for these switches. If they do not function correctly, they must be replaced as per paragraph 5.3.1.11.

k. At a reduced voltage run the capacitor from maximum to minimum and count the turns. The microswitch should stop the rotation after rotating 23 to 23½ turns.

l. Check coupling hub pin alignment as per paragraph 5.3.1.10.

NOTE

The minimum voltage necessary to run the capacitor smoothly is a function of hub pin positioning.

m. Gradually increase the power supply voltage from 0 volts to determine the minimum running voltage for both directions. The voltage necessary for smooth operation should not exceed 9 volts. If this value is exceeded by more than 10%, check for other problems that may be causing motor loading.

5.4.4 Spark Gap Assembly Adjustment

Refer to Figure 5-18 for this adjustment. The gap between the ball assembly and the acorn nut on the antenna terminal stud should be .065 to .070 inch (0.16 to 0.17 cm). This gap must be between the ball assembly and the round portion of the acorn nut. Do not set gap to hex portion of nut as this may damage Spark Gap Assembly. The gap clearance may be adjusted by either raising or lowering the ball assembly.

5.5 DISCRIMINATOR ASSEMBLY TEST CABLE FABRICATION

Construct the discriminator test cable from a three foot length of RG-58/U coaxial cable. Assemble a UG-536/U connector to one end, and strip the other end back one inch. Separate the center conductor and shield. Strip insulation from center conductor, and tin the center conductor and shield.

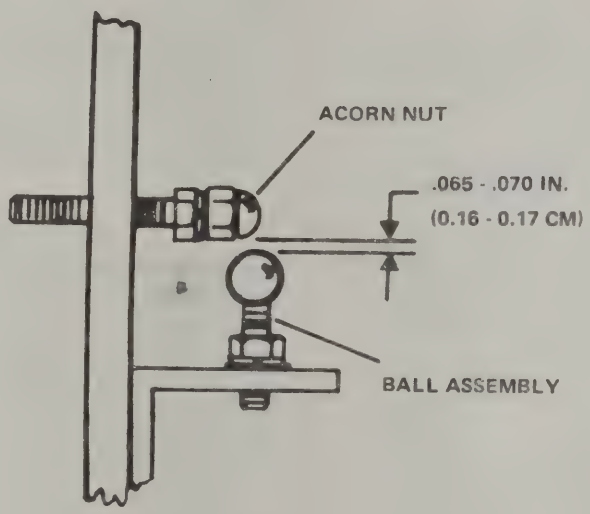


FIGURE 5-18. Spark Gap Assembly.

SECTION VI
SCHEMATIC DIAGRAMS, COMPONENT LOCATION DRAWINGS, AND PARTS LISTS

6.1 GENERAL

Complete schematics and parts lists for the SC400 are included in this section. Component location drawings are included for the individual pc board assemblies. Parts lists contain Southcom part numbers and reference designators (where appropriate).

NOTE

Parts lists contained in this section are for reference only. To order replacement parts, contact your local Southcom representative or the factory.

Figure 6-1 is a generation breakdown of the SC400. It contains references to the remaining figures and tables comprising this section.

TABLE 6-1. Parts List, SC400 Automatic Antenna Coupler, 992202

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
992390	Accessory Kit	
992326	Final Assembly	

TABLE 6-2. Parts List, Final Assembly, 992326.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
070020	Epoxy	
070035	Grease, Silicon	
070036	Desiccant	
080012	Tubing, Teflon, Clear, 12 AWG	
090003	Wire, Flat Braid, 18 AWG, 1/8 Wide	
172000	Capacitor, Vacuum Variable, 12-500 pF, 7.5 KV	C1
600025	Connector Cap 5/8''	
600027	Connector Cap 1¼''	
810025	Screw, BH, 10-32 x ½	
810030	Screw, BH, 10-24 x 5/8 Black	
810035	Screw, FH, 10-32 x ½, 100°	
810607	Screw, BH, 6-32 x ½	
810690	Screw, BH, 6-32 x 7/8	
810698	Screw, BH, 6-32 x 3/8 Brass	
810704	Screw, PH, 6-32 x ½, Swage Form	
810929	Post, Antenna Input	

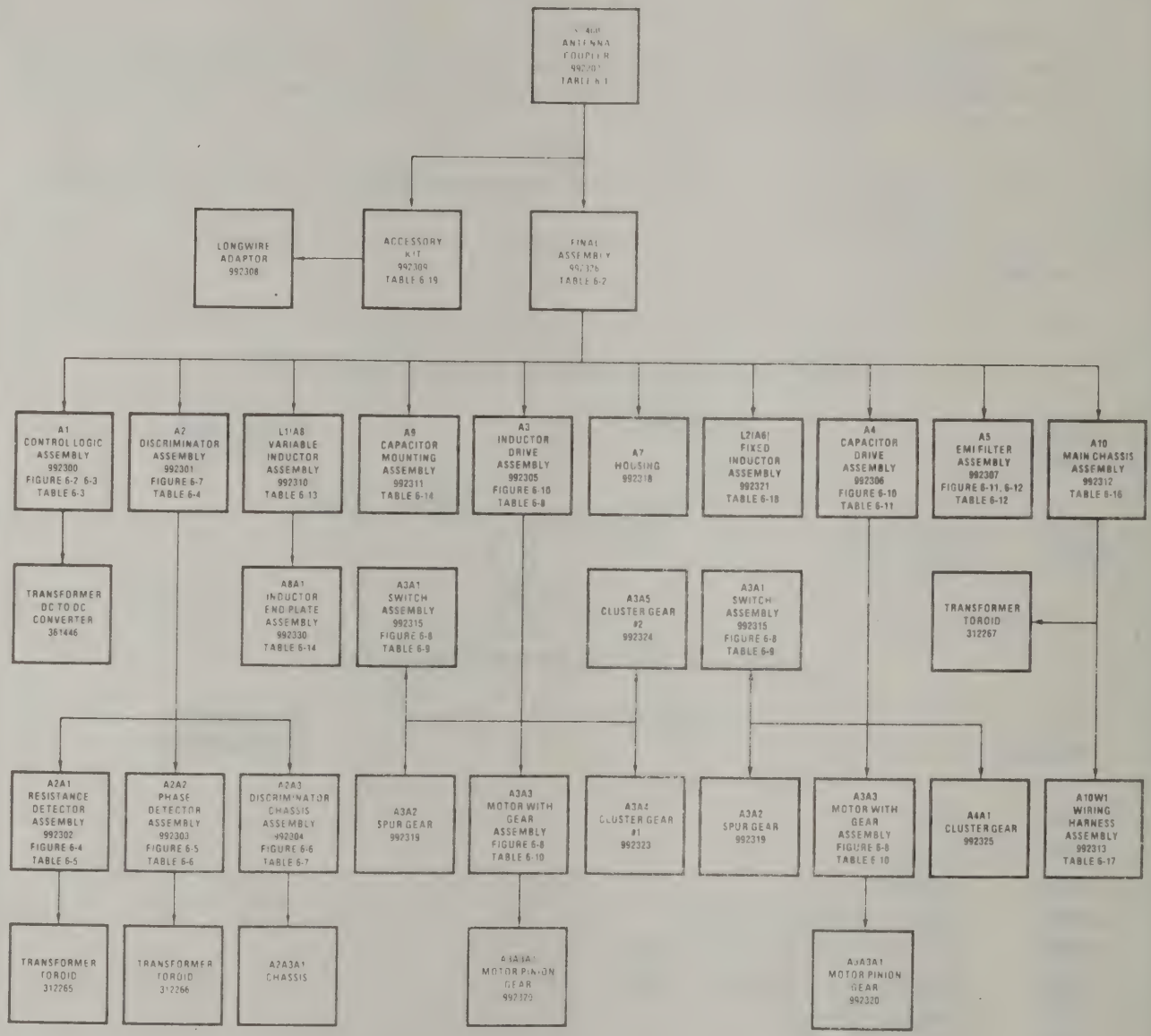

ANTENNA COUPLER
TABLE 6-1
LONGWIRE ADAPTOR 992308
ACCESSORY KIT 992309 TABLE 6-19
FINAL ASSEMBLY TABLE 6-2
A1 CONTROL LOGIC ASSEMBLY 992300 FIGURE 6-2 6-3 TABLE 6-3
A2 DISCRIMINATOR ASSEMBLY 992301 FIGURE 6-7 TABLE 6-4
L1/A8 VARIABLE INDUCTOR ASSEMBLY 992310 TABLE 6-13
A9 CAPACITOR MOUNTING ASSEMBLY 992311 TABLE 6-14
A3 INDUCTOR DRIVE ASSEMBLY 992305 FIGURE 6-10 TABLE 6-8
A7 HOUSING 992318
L2/A6/ FIXED INDUCTOR ASSEMBLY 992321 TABLE 6-18
A4 CAPACITOR DRIVE ASSEMBLY 992306 FIGURE 6-10 TABLE 6-11
A5 EMI FILTER ASSEMBLY 992307 FIGURE 6-11, 6-12 TABLE 6-12
A10 MAIN CHASSIS ASSEMBLY 992312 TABLE 6-16
TRANSFORMER DC TO DC CONVERTER 361446
A8A1 INDUCTOR END PLATE ASSEMBLY 992330 TABLE 6-14
A3A1 SWITCH ASSEMBLY 992315 FIGURE 6-8 TABLE 6-9
A3A5 CLUSTER GEAR #2 992324
A3A1 SWITCH ASSEMBLY 992315 FIGURE 6-8 TABLE 6-9
TRANSFORMER TOROID 312267
A2A1 RESISTANCE DETECTOR ASSEMBLY 992302 FIGURE 6-4 TABLE 6-5
A2A2 PHASE DETECTOR ASSEMBLY 992303 FIGURE 6-5 TABLE 6-6
A2A3 DISCRIMINATOR CHASSIS ASSEMBLY 992304 FIGURE 6-6 TABLE 6-7
A3A2 SPUR GEAR 992319
A3A3 MOTOR WITH GEAR ASSEMBLY FIGURE 6-8 TABLE 6-10
A3A4 CLUSTER GEAR #1 992323
A3A2 SPUR GEAR 992319
A3A3 MOTOR WITH GEAR ASSEMBLY FIGURE 6-8 TABLE 6-10
A4A1 CLUSTER GEAR 992325
A10W1 WIRING HARNESS ASSEMBLY 992313 TABLE 6-17
TRANSFORMER TOROID 312265
TRANSFORMER TOROID 312266
A2A3A1 CHASSIS
A3A3A2 MOTOR PINION GEAR 992320
A3A3A1 MOTOR PINION GEAR 992320

FIGURE 6-1. SC400 Generation Breakdown.

TABLE 6-2. Parts List, Final Assembly 992326, continued

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
810932-1	Screw, PH, 5/16 - 18 x 1½ Brass, Black	
811603	Nut, Hex, 6-32 x ¼	
811609	Nut, Hex, 6-32 x 5/16, Brass	
811918-1	Jam Nut, 5/16 - 18, Brass, Black	
812044-1	Washer, Split Lock, #10	
812136	Washer, Flat, #6	
812138	Washer, Split Lock, #6	
812140-1	Washer, Flat, #10, Black	
812152	Washer, Split Lock, #6, Brass	
812154	Washer, Flat, #6, Brass	
812171	Washer, Split Lock, 5/16, Brass	
812172-1	Washer, Flat, 5/16, Brass, Black	
812343	Thread Seal, 5/16	
812345	Cover Gasket	
812499	Spacer, #6 x .500 Long	
816424	Terminal Lug, Crimp, #6 Stud	
816430	Lug, Crimp, 5/16 Stud	
818219	Shaft Coupling	
821852	Post, Spark Gap	
822949	Brace, PC Housing	
822951	Bracket, Chassis Ground	
822977	Brace, Chassis	
823858	Plate, Ground, Connector	
823859	Plate, Ground, Antenna	
992300	Control Logic Assembly	A1
992301	Discriminator Assembly	A2
992305	Inductor Drive Assembly	A3
992306	Capacitor Drive Assembly	A4
992307	EMI Filter Assembly	A5
992310	Variable Inductor Assembly	L1 [A8]
992311	Capacitor Mounting Assembly	A9
992312	Main Chassis Assembly	A10
992318	Housing	A7
992321	Fixed Inductor Assembly	L2 [A6]

TABLE 6-3. Parts List, Control Logic Assembly, 992300.

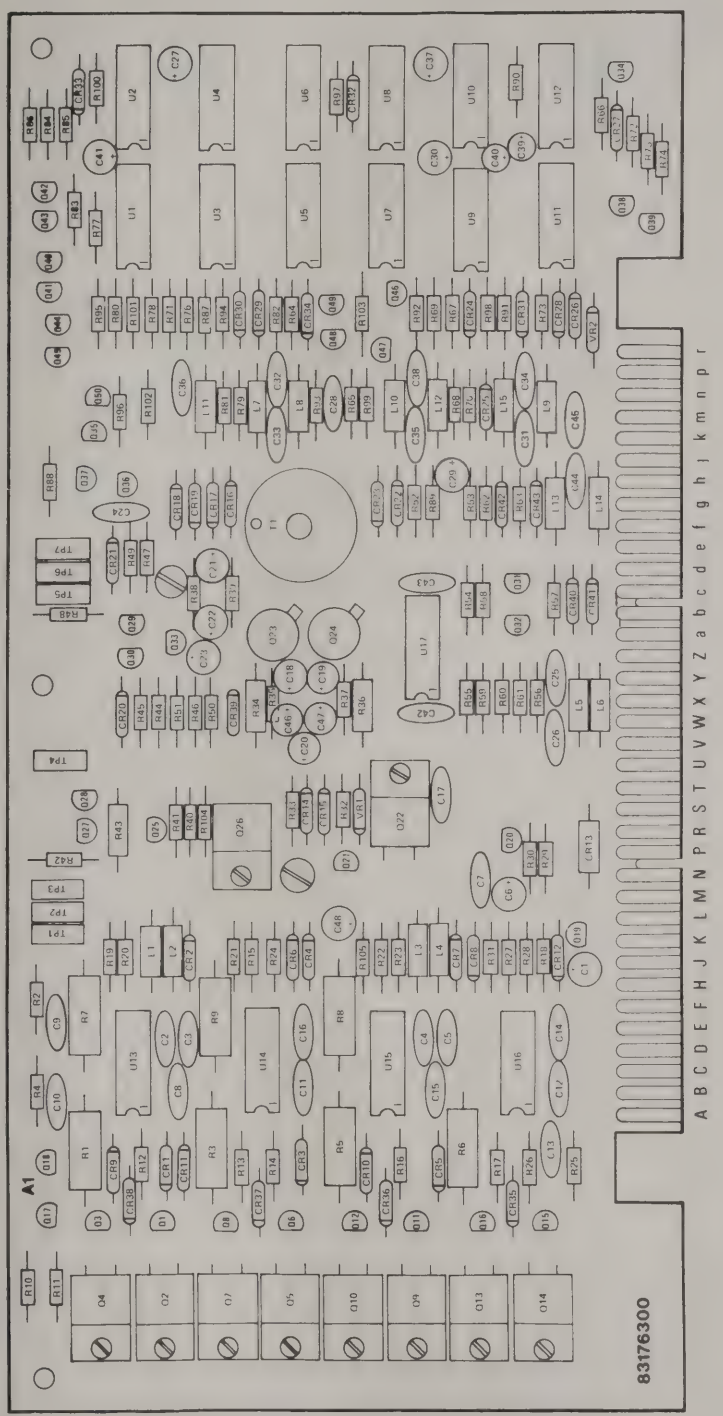
PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
080013	Tubing, Teflon, Clear, 22AWG	
111010	Capacitor, Ceramic, .01μF, 100V	C2, C3, C4, C5, C7, C8, C9, C10, C11, C12, C13, C14, C15, C17, C24, C25, C26, C28, C31, C32, C33, C34, C35, C36, C16, C38, C42, C43, C44
111106	Capacitor, Ceramic, 0.1μF, 50V	C45
151506	Capacitor, Tantalum, 15μF, 25V	C1
151507	Capacitor, Tantalum, 0.1μF, 25V	C6, C27, C30
151508	Capacitor, Tantalum, 4.7μF, 25V	C18, C19, C22
151509	Capacitor, Tantalum, 22μF, 35V	C20
151510	Capacitor, Tantalum, 33μF, 35V	C47, C46, C21
151511	Capacitor, Tantalum, 47μF, 25V	C23
151512	Capacitor, Tantalum, 1μF, 35V	C29, C39, C40, C41, C48
151513	Capacitor, Tantalum, 3.3μF, 25V	C37
215102	Resistor, Composition, 1K ohm, ¼W	R27
215103	Resistor, Composition, 10K ohm, ¼W	R2, R4, R15, R18, R19, R20, R21, R22, R23, R24, R25, R32, R47, R55, R56, R66, R70, R86, R60, R91
215104	Resistor, Composition, 100K ohm, ¼W	R65, R77, R78, R80
215105	Resistor, Composition, 1M ohm, ¼W	R64, R68, R69, R97, R100
215122	Resistor, Composition, 1.2K ohm, ¼W	R73, R74, R83, R85, R93, R96, R99, R102, R88
215132	Resistor, Composition, 1.3K ohm, ¼W	R54
215153	Resistor, Composition, 15K ohm, ¼W	R58
215183	Resistor, Composition, 18K ohm, ¼W	R53
215184	Resistor, Composition, 180K ohm, ¼W	R12
215221	Resistor, Composition, 220 ohm, ¼W	R29, R31
215222	Resistor, Composition, 2.2K ohm, ¼W	R72, R79, R81
215223	Resistor, Composition, 22K ohm, ¼W	R13, R14, R17, R26, R71, R75, R76, R82, R84, R87, R92, R94, R95, R98, R101
215224	Resistor, Composition, 220K ohm, ¼W	R67
215273	Resistor, Composition, 27K ohm, ¼W	R28, R59
215332	Resistor, Composition, 3.3K ohm, ¼W	R10, R11, R41
215392	Resistor, Composition, 3.9K ohm, ¼W	R51, R52, R89, R105
215393	Resistor, Composition, 39K ohm, ¼W	R57, R61
215394	Resistor, Composition, 390K ohm, ¼W	R16
215470	Resistor, Composition, 47 ohm, ¼W	R30
215471	Resistor, Composition, 470 ohm, ¼W	R40, R44, R42
215472	Resistor, Composition, 4.7K ohm, ¼W	R38, R39, R104

TABLE 6-3, Parts List, Control Logic Assembly, 992300, continued.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
215473	Resistor, Composition, 47K ohm, ¼W	R45, R48
215514	Resistor, Composition, 510K ohm, ¼W	R46
215561	Resistor, Composition, 560 ohm, ¼W	R35, R37
215562	Resistor, Composition, 5.6K ohm, ¼W	R50
215564	Resistor, Composition, 560K ohm, ¼W	R90
215683	Resistor, Composition, 68K ohm, ¼W	R49, R62, R63
215820	Resistor, Composition, 82 ohm, ¼W	R33
225222	Resistor, Composition, 2.2K ohm, ½W	R43, R103
225472	Resistor, Composition, 4.7K ohm, ½W	R34, R36
235102	Resistor, Composition, 1K ohm, 1W	R1, R3, R5
235222	Resistor, Composition, 2.2K ohm, 1W	R6, R7, R8, R9
340022	Inductor, RF Choke, 1000μH	L14
342011	Inductor, RF Choke, 100μH	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L15
361446	Transformer	T1
410003	Diode, Silicon, 1N4148	CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11, CR12, CR41, CR14, CR15, CR20, CR21, CR22, CR23, CR24, CR25, CR26, CR27, CR28, CR29, CR30, CR32, CR33, CR34, CR35, CR36, CR37, CR38, CR40, CR31
410015	Diode, Silicon, 1N5711	CR42, CR43
410018	Diode, 1N4721	CR13
410019	Diode, 1N4245	CR16, CR17, CR18, CR19, CR39
430023	Diode, Zener, 1N4749	VR1
430024	Diode, Zener, 1N4755	VR2
440038	Transistor, MPSA05	Q1, Q6, Q11, Q15, Q40, Q41, Q42, Q43, Q44, Q45, Q46, Q48, Q49
440039	Transistor, MPSA55	Q3, Q8, Q12, Q16, Q17, Q18
440040	Transistor, MPSA56	Q21, Q25, Q47
440041	Transistor, MPSA06	Q27, Q28, Q35, Q36, Q37, Q38, Q39, Q50
440042	Transistor, 2N5493	Q5, Q9, Q14, Q22, Q2
440043	Transistor, 2N6108	Q4, Q7, Q10, Q13, Q26
440044	Transistor, 2N4125	Q19, Q29, Q31, Q32
440045	Transistor, 2N4123	Q30, Q33, Q34

TABLE 6-3. Parts List, Control Logic Assembly, 992300, continued.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
440046	Transistor, MU-10	Q20
440047	Transistor, 2N5784	Q23, Q24
460015	Integrated Circuit, 4001	U2, U3
460016	Integrated Circuit, 4012	U9
460040	Integrated Circuit, 4002	U6
460041	Integrated Circuit, 4011	U1, U4, U5, U7, U8, U10, U11 U12
460082	Integrated Circuit, CA747C	U13, U14, U15, U16, U17
620042	Test Jack, Red	TP2
620043	Test Jack, Green	TP5
620044	Test Jack, Blue	TP6
620045	Test Jack, Orange	TP3
620046	Test Jack, Yellow	TP4
620047	Test Jack, Brown	TP1
620048	Test Jack, Purple	TP7
810451	Screw, BH, 4-40 x 5/16	
810494	Screw, RH, 4-40 x ¼, Nylon	
810832	Screw, FH, 8-32x 1 1/32, 100° Nylon	
811407	Nut, Hex, 4-40 x 3/16	
811806	Nut, Hex, 8-32 x 11/32, Nylon	
812135	Washer, Flat, #4	
812143	Washer, Split Lock, #4	
812482	Standoff, Nylon, ¼ OD, 4-40 x ¼	
822946	Cover, PC Board Housing	
831763	PC Board Control Logic	



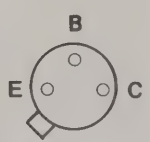
2N6109

TOP VIEW

2N6108/2N5493,

TOP VIEW

2N5784



BOTTOM VIEW

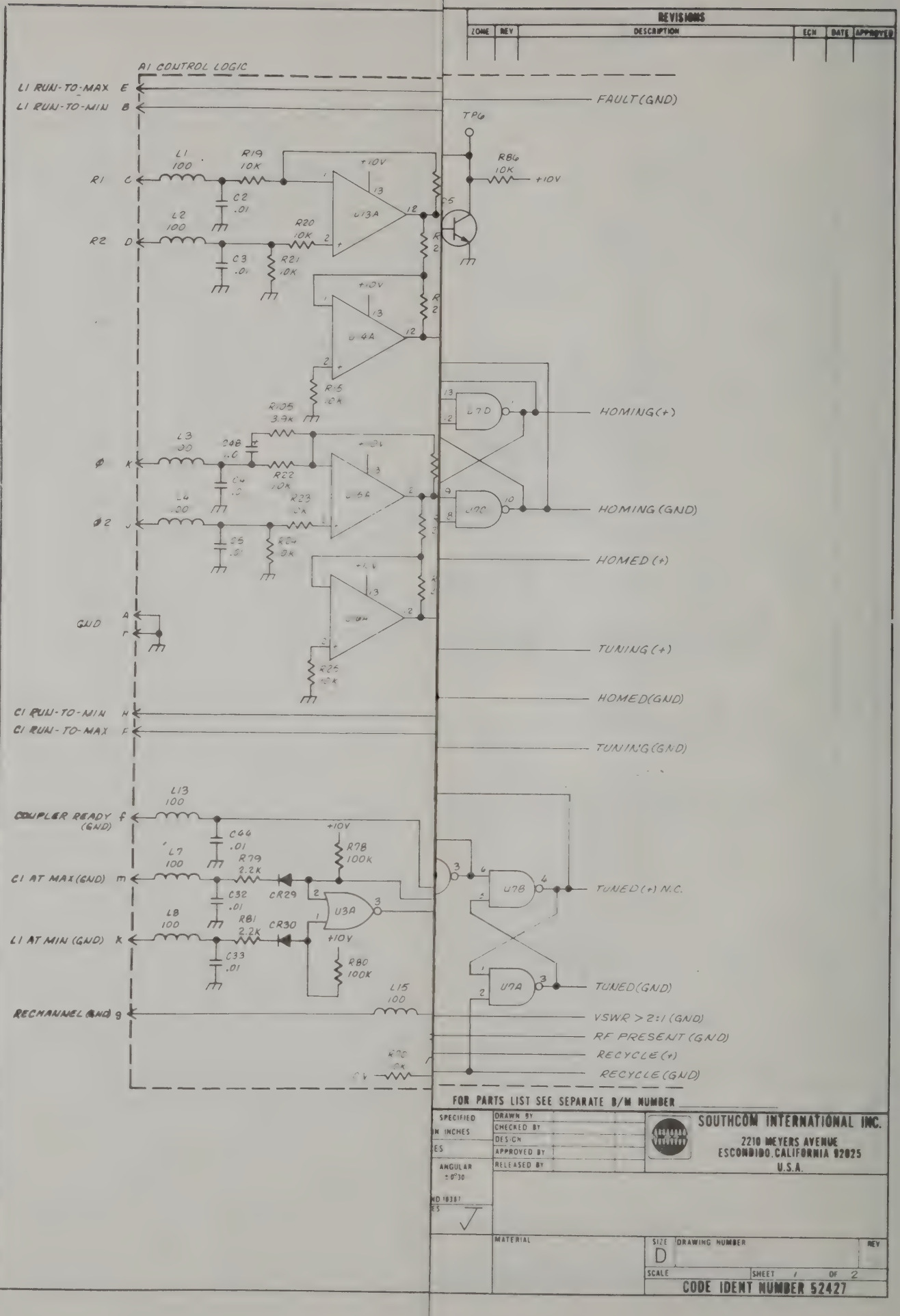
Q20 UNIJUNCTION

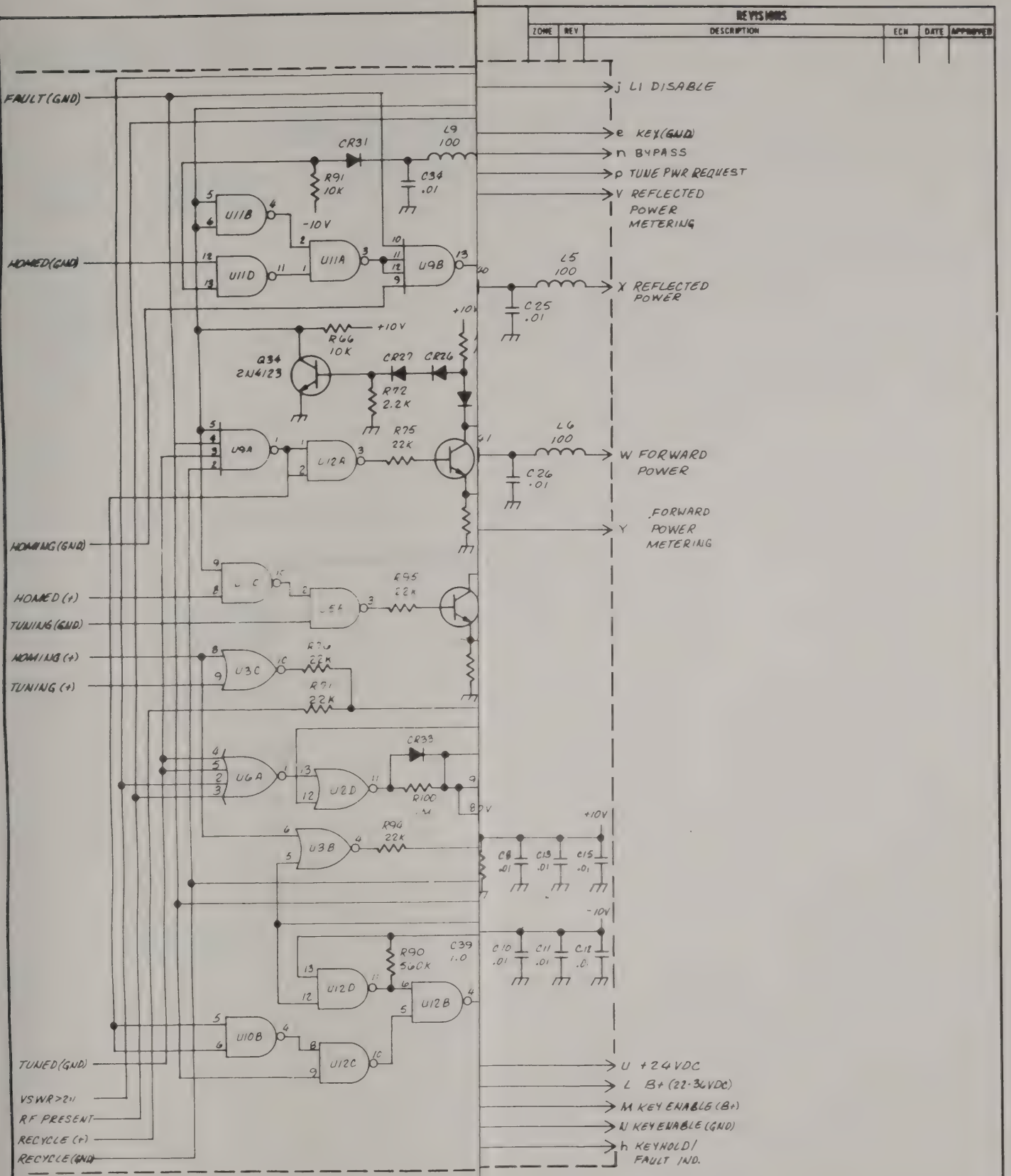
BOTTOM VIEW

2N4125/2N4123/ MPSA05/MPSA06/ MPSA55/MPSA56

BOTTOM VIEW

FIGURE 6-2. Component Locations, Control Logic PC Board Assembly, A1.


REVISIONS
ZONE
REV
DESCRIPTION
ECN
DATE
APPROVED
A1 CONTROL LOGIC
L1 RUN-TO-MAX E
L1 RUN-TO-MIN B
FAULT (GND)
TP6
RB6 10K
+10V
R1 C
R2 D
L1 100
L2 100
L3 .00
L4 .00
R19 10K
R20 10K
R21 10K
R22 10K
R23 10K
C2 .01
C3 .01
C4 .0
C5 .01
C6B .0
U3A
U4A
U5A
U5B
U5C
U5D
HOMING(+)
HOMING (GND)
HOMED (+)
TUNING (+)
HOMED(GND)
TUNING(GND)
Ø K
Ø2 J
GND A F
C1 RUN-TO-MIN H
C1 RUN-TO-MAX F
L13 100
COUPLER READY (GND) f
C1 AT MAX(GND) m
L1 AT MIN (GND) k
RECHANNEL (GND) g
L7 100
L8 100
L15 100
C44 .01
C32 .01
C33 .01
R78 100K
R79 2.2K
R81 2.2K
R80 100K
CR29
CR30
U3A
U7A
U7B
TUNED(+) N.C.
TUNED(GND)
VSWR > 2:1 (GND)
RF PRESENT (GND)
RECYCLE (+)
RECYCLE (GND)
FOR PARTS LIST SEE SEPARATE B/M NUMBER
SOUTHCOM INTERNATIONAL INC.
2210 MEYERS AVENUE
ESCONDIDO, CALIFORNIA 92025
U.S.A.
DRAWN BY
CHECKED BY
DESIGN
APPROVED BY
RELEASED BY
SPECIFIED IN INCHES
ANGULAR ±0°30
MATERIAL
SIZE D
DRAWING NUMBER
REV
SCALE
SHEET 1 OF 2
CODE IDENT NUMBER 52427



BISHOP GRAPHICS ACCUPRESS
REORDER NO. A 2531

REVISIONS					
ZONE	REV	DESCRIPTION	ECN	DATE	APPROVED

A1 CONTROL LOGIC

L1 RUN-TO-MAX E
L1 RUN-TO-MIN B
C1 RUN-TO-MIN H
C1 RUN-TO-MAX F
COUPLER READY (GND) f
C1 AT MAX (GND) m
L1 AT MIN (GND) k
RECHANNEL (GND) g
GND A, r
R1 C
R2 D
Ø1 K
Ø2 J

L1 100, L2 100, L3 100, L4 100, L7 100, L8 100, L13 100, L15 100
C2 .01, C3 .01, C4 .01, C5 .01, C6 .1, C7 .01, C8B 1.0, C29 1.0, C30 .1, C31 .01, C32 .01, C33 .01, C46 .01
R19 10K, R20 10K, R21 10K, R22 10K, R23 10K, R24 10K, R25 10K, R105 3.9K
R12 180K, R13 22K, R14 22K, R15 10K, R16 390K, R17 22K, R26 22K
U13A, U13B, U14A, U14B, U15A, U15B, U16A, U16B
+10V, +24V, -10V, 0V
TP1
R7 2.2K 1W, R9 2.2K 1W, R8 2.2K 1W, R6 2.2K 1W
R1 1K 1W, R3 1K 1W, R5 1K 1W
Q3 MPSA55, Q1 MPSA05, Q4 2N6108, Q2 2N5493
Q8 MPSA55, Q6 MPSA05, Q7 2N6108, Q5 2N5493
Q12 MPSA55, Q11 MPSA05, Q10 2N6108, Q9 2N5493
Q16 MPSA55, Q15 MPSA05, Q13 2N6108, Q14 2N5493
CR37, CR36, CR35
CR9, CR1, CR2, CR3, CR4, CR10, CR5, CR8
R2 10K, R10 3.3K, Q18 MPSA55
R4 10K, R11 3.3K, MPSA55
Q44 MPSA05, Q45, R87 22K, R88 1.2K
U5C, U4A, R84 22K, Q42 MPSA05, Q43, R85 1.2K, R86 10K, TP6
HOMING (GND)
RF PRESENT (GND)
RECYCLE (GND)
ELEMENTS HOME (+)
HOMING (+)
U7D, U7C, U5B
HOMING (+)
HOMING (GND)
U3D, U1D, U1A, U5D, U2B, U2A, U1B
HOMED (+)
TUNING (+)
HOMED (GND)
TUNED (GND)
VSWR > 2:1 (GND)
RF PRESENT (GND)
RECYCLE (+)
RECYCLE (GND)
U3C, U8D, U1C, U8A, U7A, CR32, C34 3.3, R97 M, TP5
R27 1K, R28 27K, R31 220, R29 220, C7 .01, C1 15, C6 .1, R30 47, R18 10K, CR12, Q19 2N4125, Q20 UNIJUNCTION
R68 1M, R67 220K, R69 1M, R70 10K, C29 1.0, C31 .01, C30 .1, CR25, CR24, U10A, U10D
R81 2.2K, R80 100K, R78 100K, R79 2.2K, C32 .01, C46 .01, CR29, CR30, U3A

FOR PARTS LIST SEE SEPARATE B/M NUMBER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	DRAWN BY	SOUTHCOM INTERNATIONAL INC.	
TOLERANCES	CHECKED BY	2210 MEYERS AVENUE ESCONDIDO, CALIFORNIA 92025 U.S.A.	
LINEAR XX ±.03 XXX ±.010 ANGULAR ±0°30	DESIGN		
HOLES PER ANSI B32.1	APPROVED BY		
ALL MACHINED SURFACES √	RELEASED BY		
FINISH	MATERIAL	SIZE D	DRAWING NUMBER — REV
		SCALE	SHEET 1 OF 2
		CODE IDENT NUMBER 52427	

QTY REQD	COMMERCIAL	MILITARY	NEXT ASSY
	USED ON		

ZONE	REV	DESCRIPTION	ECN	DATE	APPROVED

REVISIONS

FAULT(GND)
HOMED(GND)
HOMING(GND)
HOMED(+)
TUNING(GND)
HOMING(+)
TUNING(+)
TUNED(GND)
VSWR>2:1
RF PRESENT
RECYCLE(+)
RECYCLE(GND)

j LI DISABLE
e KEY(GND)
n BYPASS
p TUNE PWR REQUEST
V REFLECTED POWER METERING
X REFLECTED POWER
W FORWARD POWER
Y FORWARD POWER METERING
U +24VDC
L B+ (22-30VDC)
M KEY ENABLE (B+)
N KEY ENABLE (GND)
h KEYHOLD/ FAULT IND.

BYPASS(GND)

CR31 L9 100 C34 .01 R91 10K -10V
U11B U11D U11A U9B R92 22K Q48 MPSA05 Q49 R93 1.2K L10 100 C35 .01
U9A U12A R75 22K Q39 MPSA06 Q38 R74 1.2K
Q34 2N4123 R46 10K +10V R73 1.2K CR27 CR26 R72 2.2K CR28
YR2 43V C45 .1 L16 1000
U5C U5A R95 22K Q50 MPSA06 Q35 R96 1.2K C36 .01 L11 100
U3C R76 22K R71 22K
U6A U2D CR33 R100 1M C41 1.0 U1C U2C U8C U8B U3B R94 22K
U12D U12B R90 560K C39 1.0 C40 1.0 R98 22K
U10B U12C R103 2.2K 1/2W R99 1.2K +24V Q46 MPSA05 Q47 MPSA56 L12 100 C38 .01
U6B U6D U6C R66 1M C28 .01 C27 .1 CR34 R65 100K
R46 510K CR20 R45 47K C23 47 Q39 2N4123
Q29 2N4129 R69 68K C24 .01 CR21 R47 10K R48 47K Q30 2N4123 R51 3.9K R50 5.6K
R61 39K +10V R60 10K Q32 2N4125 CR42 CR40 R62 68K C25 .01 L5 100
C42 .01 9,13 U17A RB9 3.9K CR23 R58 15K R55 10K
R56 10K Q31 2N4125 CR41 CR43 R69 68K C26 .01 L6 100
R52 3.9K U17B CR22 R57 39K R53 18K R54 A3K C43 .01
R35 560 R34 4.7A 1/2W C18 47 CR39 1N4245 +23 2A57BV C20 22
CR16 CR15 CR13 1N4727 R33 82 R32 .1K C17 .01 Q21 MPSA56 VR1 24V TP3 Q22 2N5493
P +24V Q1 2N6109 R
C16 .01 C14 .01 C9 .01 R36 4.7A 1/2W R37 560 C19 47 Q24 2N5784
CR16 CR17 CR18 1N4245 CR19 TP7 +10V C21 33 R38 4.7K C8 .01 C13 .01 C15 .01 C22 47 R39 4.7K TP4 C10 .01 C11 .01 C12 .01 -10V

R81 3.3K R80 470 Q24 2N6028 R63 2.2K 1/2W R102 4.7K Q28 MPSA06 Q27 R42 470

FOR PARTS LIST SEE SEPARATE B/M NUMBER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
LINEAR XX ±.01 XXX ±.010
ANGULAR ±1°30
HOLES PER ANSI B32.1
ALL MACHINED SURFACES
FINISH
MATERIAL

DRAWN BY
CHECKED BY
DESIGN
APPROVED BY
RELEASED BY

SOUTHCOM INTERNATIONAL INC.
2210 MEYERS AVENUE
ESCONDIDO, CALIFORNIA 92025
U.S.A.

SIZE D | DRAWING NUMBER | REV
SCALE | SHEET 2 OF 2
CODE IDENT NUMBER 52427

QTY REQD	COMMERCIAL	MILITARY	NEXT ASSY
	USED ON		

NOTE: UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A 2531

TABLE 6-4. Parts List, Discriminator Assembly, 992301.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
010565	Wire, Buss. 22AWG, Tinned	
080013	Tubing. Teflon, Clear, 22AWG	
810439	Screw. BH. 4-40 x ¼	
812135	Washer. Flat. #4	
812143	Washer. Split Lock. #4	
822933	Cover. Discriminator	
992302	Resistance Detector Assembly	A2A1
992303	Phase Detector Assembly	A2A2
992304	Discriminator Chassis Assembly	A2A3

TABLE 6-5. Parts List. Resistance Detector Assembly, 992302.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
111010	Capacitor, Ceramic, .01 μF, 100V	C2, C3, C4, C5
125331	Capacitor. Mica 330pF, 500V	C1
200331	Resistor. Film. 332 ohm, 1/8W	R1, R2
200472	Resistor. Film. 4.75K ohm, 1/8W	R4, R5
215331	Resistor, Composition, 330 ohm, ¼W	R3
215561	Resistor. Composition, 560 ohm, ¼W	R6
312265	Transformer. Toroid	T1, T2
340022	Inductor. RF Choke, 1000μH	L2
342013	Inductor. RF Choke, .68μH	L1
410015	Diode. Silicon. 1N5711	CR1, CR2, CR3, CR4
816322	Pin. Connector	
831761	PC Board, Resistance Detector	

TABLE 6-6. Parts List, Phase Detector Assembly, 992303.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
111010	Capacitor, Ceramic, .01μF, 100V	C1, C2
215242	Resistor, Composition, 2.4K ohm, ¼W	R5, R6
225331	Resistor, Composition, 330 ohm, ½W	R3
245681	Resistor, Composition, 680 ohm, 2W	R1, R2
270031	Potentiometer, 10K	R4
312266	Transformer, Toroid	T1, T2
410015	Diode, Silicon, 1N5711	CR1, CR2
816322	Pin, Connector	
831762	PC Board, Phase Detector	

TABLE 6-7. Parts List, Discriminator Chassis Assembly, 992304.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
000570	Cable, RG142B/U	
127051	Capacitor, Glass, Fixed, 5.1pF, 5%, 500V	C1
172001	Capacitor, Glass, Variable, .8-8.5pF	C2
312264	Transformer, Toroid	T1, T2
610060	Connector, MX-1684/U	
620049	Connector, Type 'N', UG556B/U	
812162	Washer, Nylon, ½ O.D.	
812163	Washer, Nylon, .555 O.D.	
812480	Spacer, Tubing	
812995	Ring, Retaining	
815011	Insulator, Screw #10	
816305	Post, Feedthru, Teflon, White	
816321	Pin, Jack, Feedthru	
992316	Discriminator Chassis	

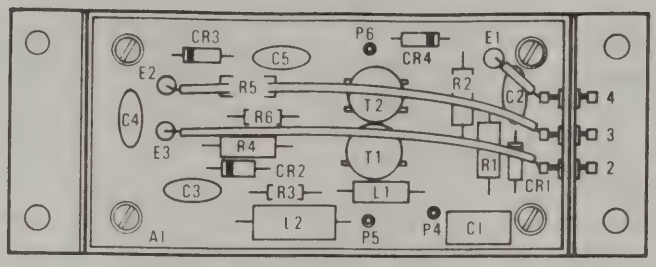


FIGURE 6-4. Component Locations, Resistance Detector PC Board Assembly, A2A1.

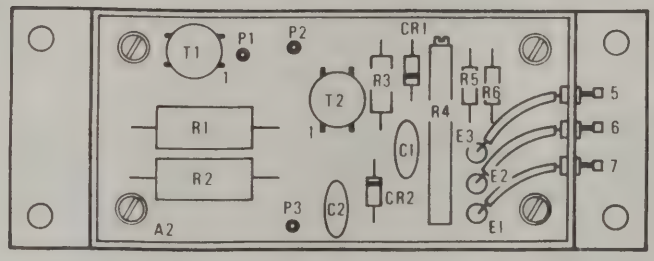


FIGURE 6-5. Component Locations, Phase Detector PC Board Assembly, A2A2.

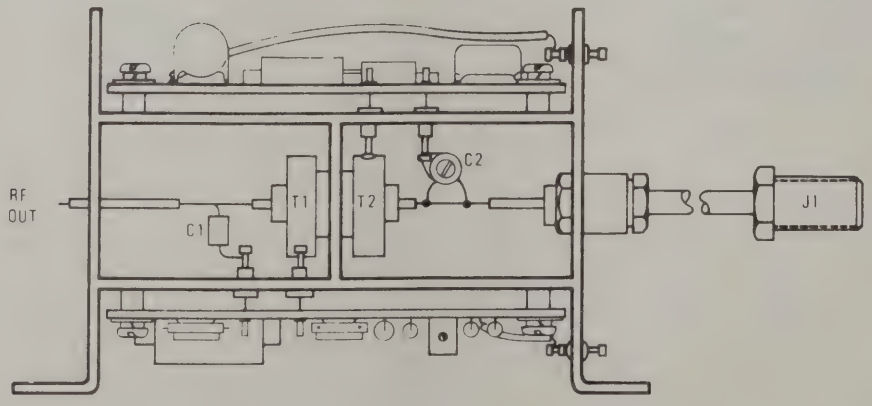


FIGURE 6-6. Component Locations, Discriminator Chassis Assembly, A2A3.

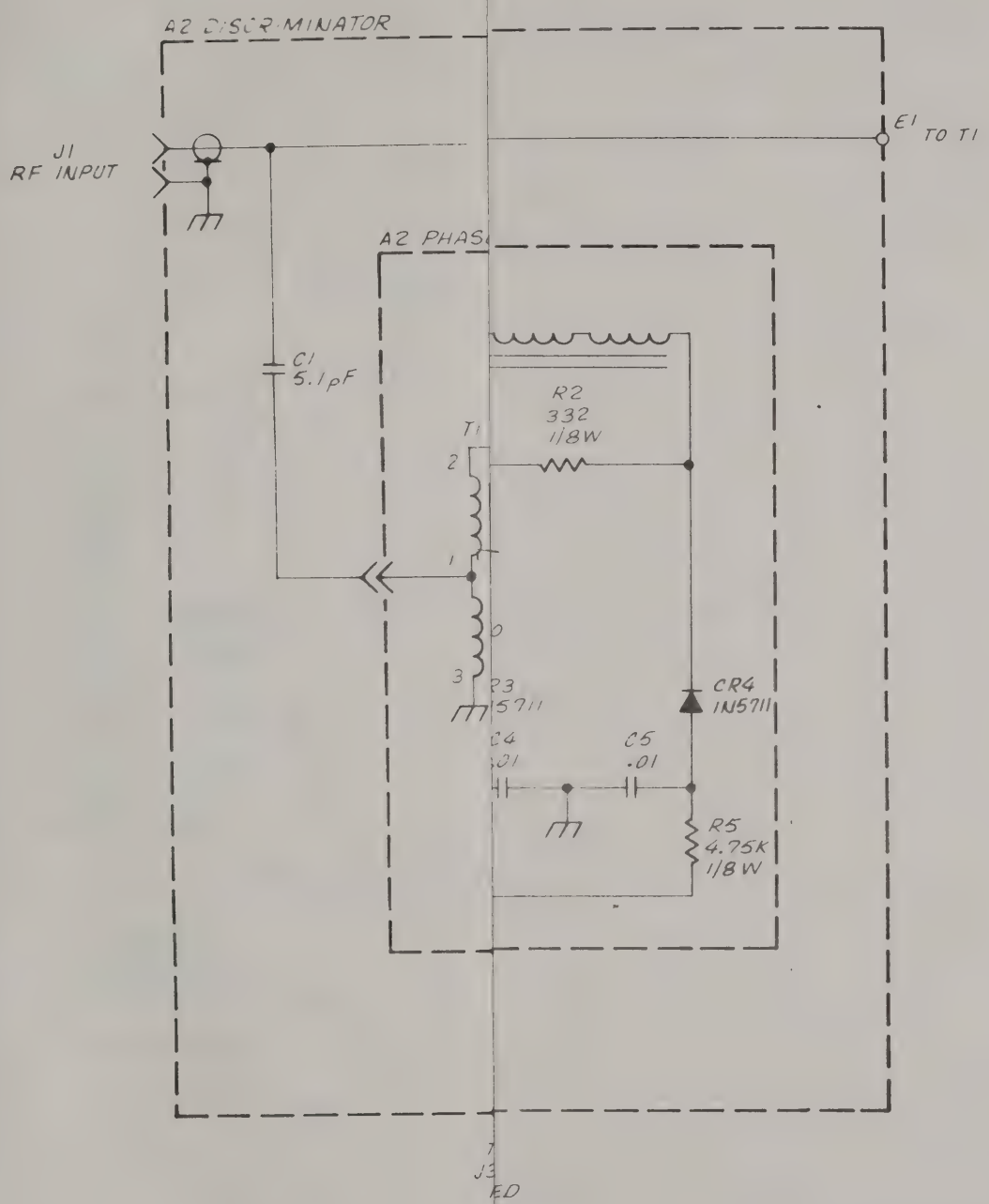


FIGURE 6-7. Schematic Diagram, Discriminator.

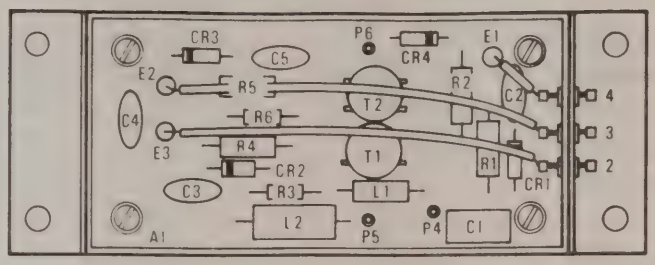


FIGURE 6-4. Component Locations, Resistance Detector PC Board Assembly, A2A1.

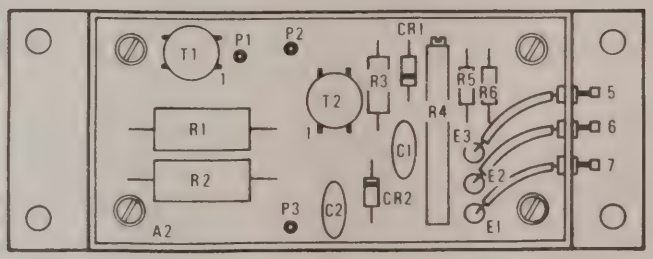


FIGURE 6-5. Component Locations, Phase Detector PC Board Assembly, A2A2.

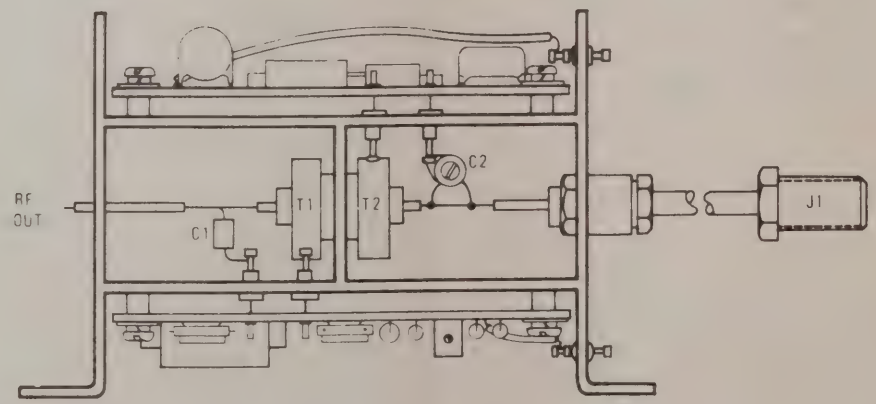


FIGURE 6-6. Component Locations, Discriminator Chassis Assembly, A2A3.

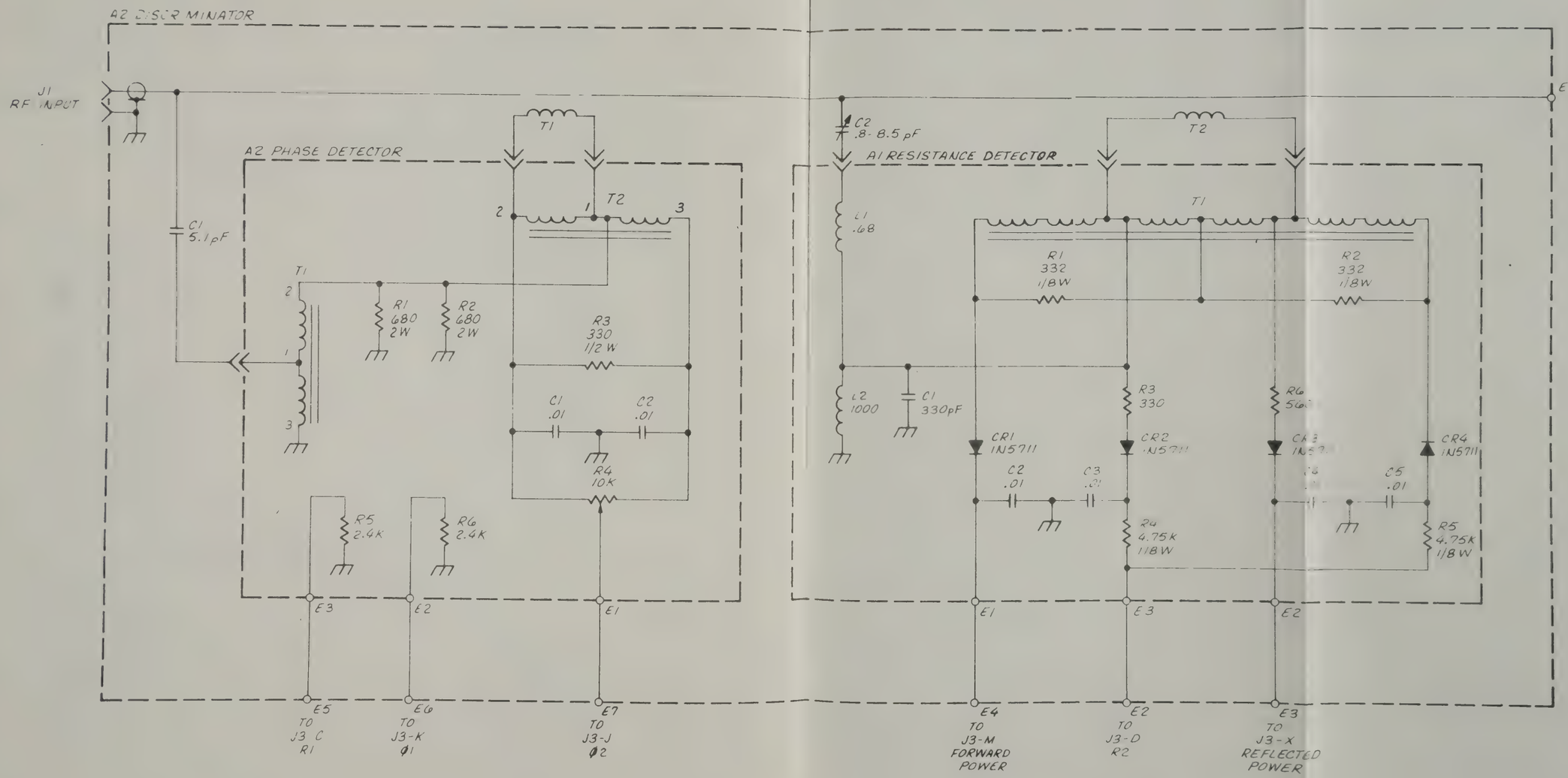


FIGURE 6-7. Schematic Diagram, Discriminator.

TABLE 6-8. Parts List, Inductor Drive Assembly, 992305

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
070034	Loctite, Screw Lock	
810454	Screw, FH, 4-40 x ¼, 100°	
810493	Screw, PH, 4-40 x 5/16	
810701	Screw, PH, 6-32 x ½	
812116	Spacer, Teflon	
812138	Washer, Split Lock, #6	
812143	Washer, Split Lock, #4	
812164	Washer, Flat, #4	
812483	Standoff, Round, 4-40 x ¼	
812484	Spacer, Nylon, .50 Long	
812485	Spacer, Nylon, .437 Long	
812994	Ring, Retaining	
813011	Tie, Cable	
821850	Actuator Arm	
822947	Mounting Angle	
823855	Gear Plate, Inductor Drive	
992315	Switch Assembly	A3A1
992319	Spur Gear	A3A2
992322	Motor with Gear Assembly	A3A3
992323	Cluster Gear #1	A3A4
992324	Cluster Gear #2	A3A5

TABLE 6-9. Parts List, Limit Switch Assembly, 992315.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
410019	Diode, 1N4245	CR1, CR2, CR3
700024	Switch, SPDT	S1, S2
810215	Screw, PH, 2-56 x 9/16	
811202	Nut, Hex, 2-56 x 3/16	
812134	Washer, Flat, #2	
812138	Washer, Split Lock, #6	
812145	Washer, Split Lock, #2	
816126	Lug, Flat, #2	
821847	Plate, Mounting, Limit Switch	

TABLE 6-10. Parts List, Motor/Gear Assembly, 992322.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
800029	Motor, DC	B1, B2
814322	Roll Pin, 1/16 x 3/8	
992320	Motor Pinion Gear	A3A3A1

TABLE 6-11. Parts List, Capacitor Drive Assembly, 992306.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
070034	Loctite, Screw Lock	
810454	Screw, FH, 4-40 x ¼, 100°	
810493	Screw, PH, 4-40 x 5/16	
810701	Screw, PH, 6-32 x ½	
812116	Spacer, Teflon	
812136	Washer, Flat, #6	
812138	Washer, Split Lock, #6	
812143	Washer, Split Lock, #4	
812164	Washer, Flat, #4	
812483	Standoff, Round, 4-40 x ¼	
812484	Spacer, Nylon, .50 Long	
812485	Spacer, Nylon, .437 Long	
812994	Ring, Retaining	
813011	Tie, Cable	
816140	Lug, Solder, #6	
821850	Actuator Arm	
822947	Mounting Angle	
823856	Gear Plate, Capacitor Drive	
992315	Switch Assembly	A3A1
992319	Spur Gear	A3A2
992322	Motor with Gear Assembly	A3A3
992325	Cluster Gear	A4A1

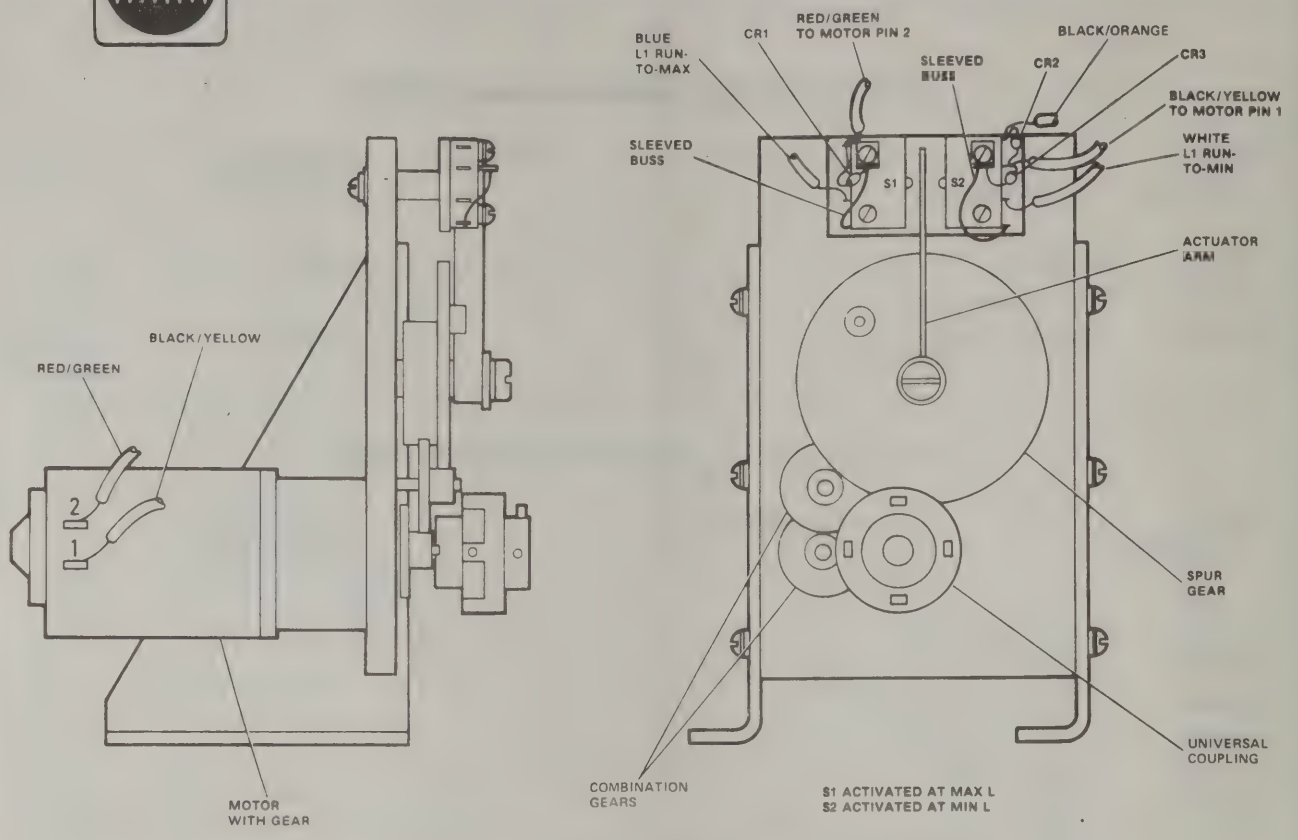


FIGURE 6-8. Component Locations, Inductor Drive Assembly.

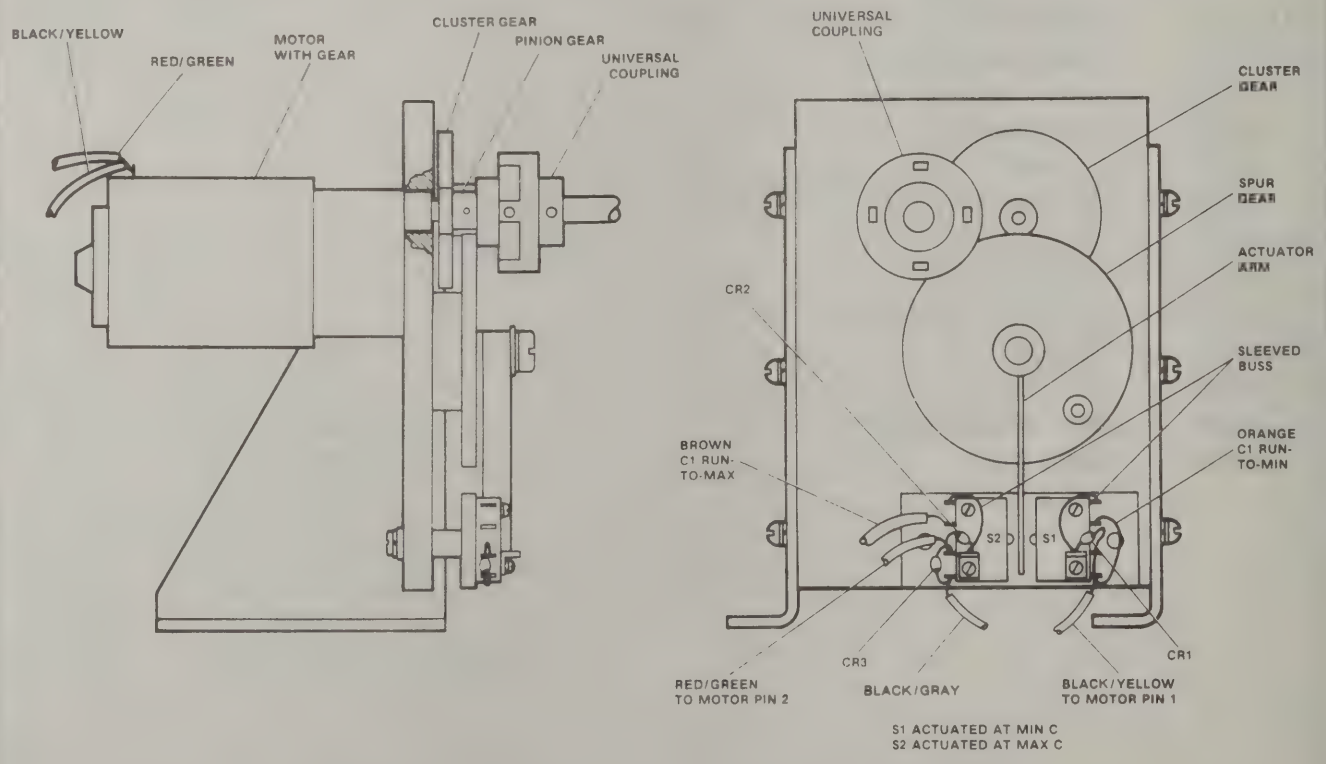


FIGURE 6-9. Component Locations, Capacitor Drive Assembly.

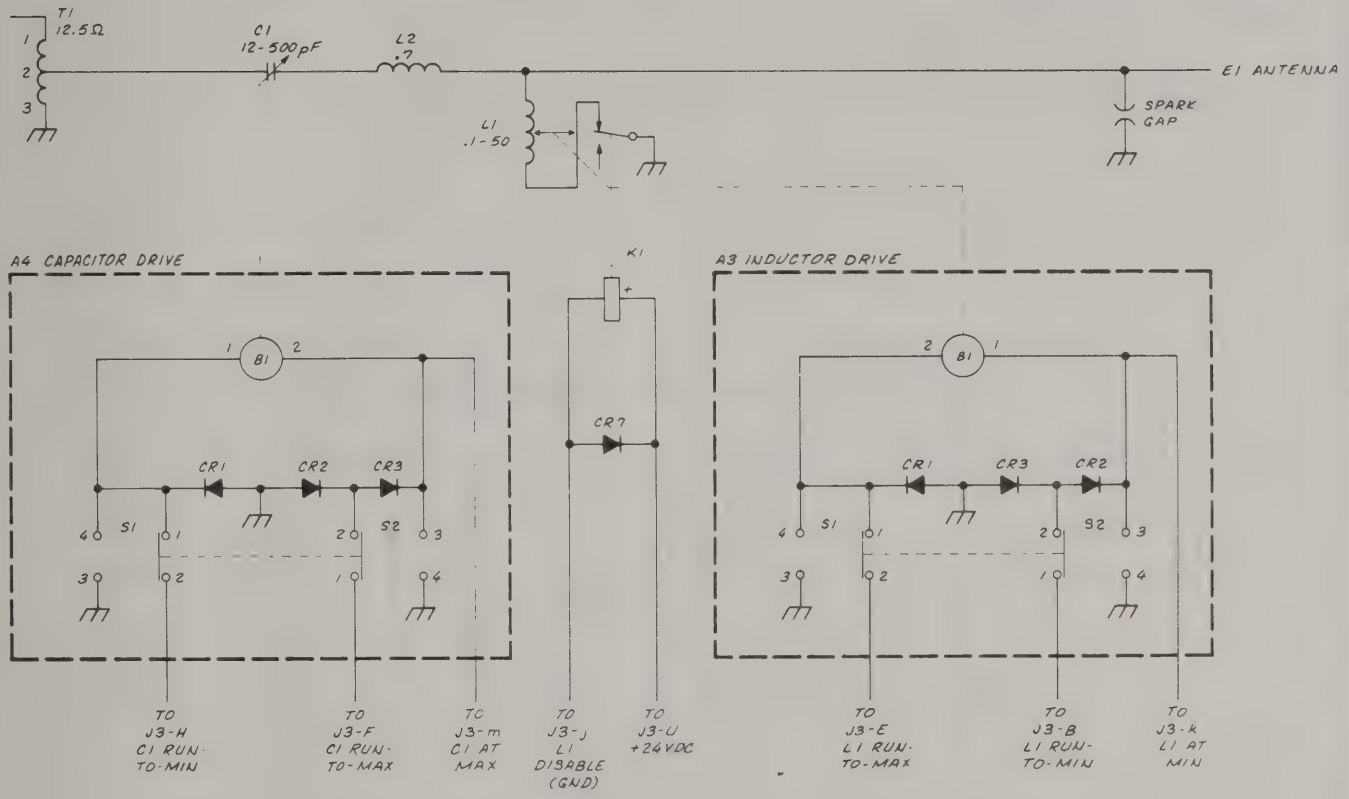


FIGURE 6-10. Schematic Diagram, Inductor Drive and Capacitor Drive.

TABLE 6-12. Parts List, EMI Filter Assembly, 992307.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
111010	Capacitor, Ceramic, .01μF, 100V	C1, C2, C3, C4, C5, C6, C7,
610058	Connector, Chassis	
812148	Washer, Flat, 2'' O.D.	
814202	Eyelet	
822934	Ground Strap	
831760	PC Board, EMI Filter	

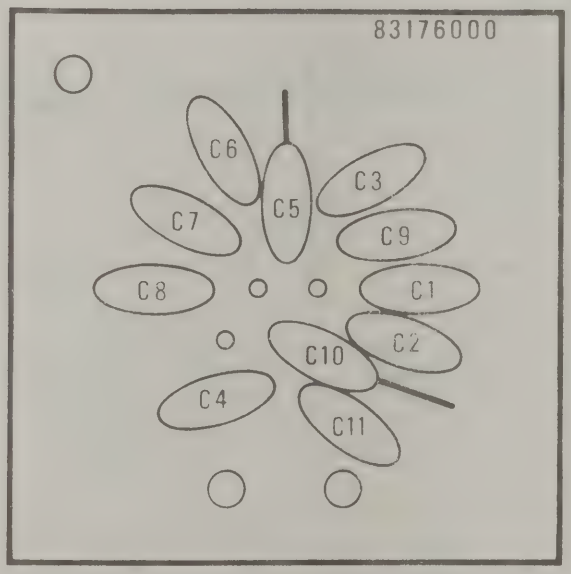


FIGURE 6-11. Component Locations, EMI Filter PC Board Assembly.

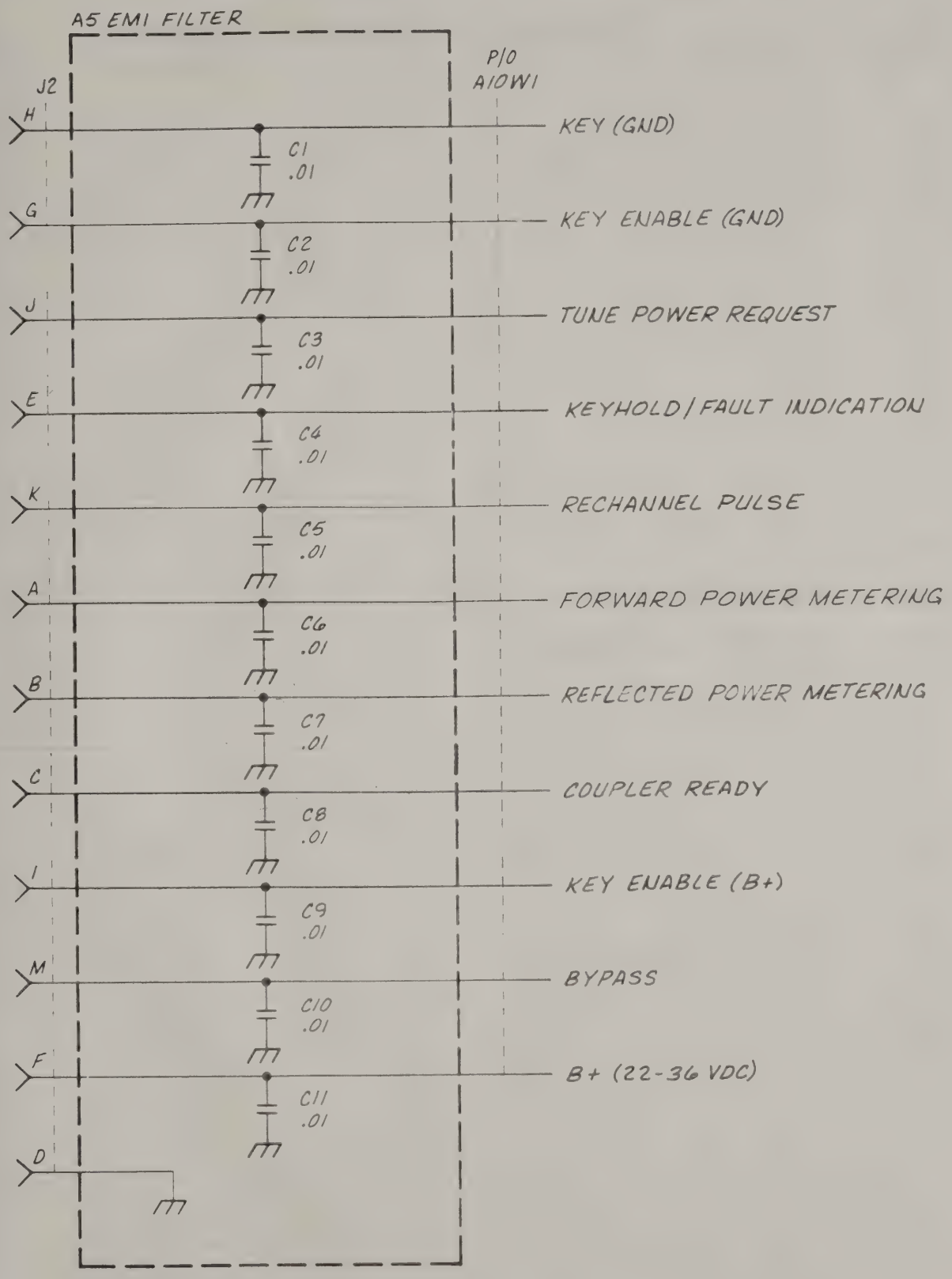


FIGURE 6-12. Schematic Diagram, EMI Filter.

TABLE 6-13. Parts List, Variable Inductor Assembly, 992310.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
000571	Wire, 16 AWG, Silver Plated	
080012	Tubing, Teflon, Clear, 12 AWG	
090003	Wire, Flat Braid, 18 AWG, 1/8 Wide	
810656	Screw, BH, 6-32 x 3/4	
812136	Washer, Flat, #6	
812138	Washer, Split Lock, #6	
812481	Washer, Spring, 1/4 ID	
816424	Terminal Lug, Crimp, #6 Stud	
818424	Spring	
821810	Contact	
821863	Bracket, Contact	
822929	End Plate	
822938	Shaft, Drive	
822940	Terminal, Inductor	
822943	Bar, Inductor	
822944	Mounting Bracket	
822945	Shaft, Contact Wheel	
822948	Contact Wheel	
824839-1	Drum, Coated	
992330	Inductor End Plate Assembly	A8A1

TABLE 6-14. Parts List, Inductor End Plate Assembly, 992330.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
070020	Epoxy Kit, Clear	
812501	Press-Stud, 4-40 x 5/8, Brass	
818731	Bearing, Flange	
821867	Rod	
822941	Plate, Inductor	

TABLE 6-15. Parts List, Capacitor Mounting Assembly, 992311.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
810690	Screw, BH, 6-32 x 7/8	
810711	Screw, PH, 6-32 x 7/8, Brass	
810828	Screw, PH, 8-32 x 7/8, Brass	
811603	Nut, Hex, 6-32 x ¼	
811609	Nut, Hex, 6-32 x 5/16, Brass	
811805	Nut, Hex, 8-32 x 5/16, Brass	
812130	Washer, Flat, #8, Brass	
812136	Washer, Flat, #6	
812138	Washer, Split Lock, #6	
812152	Washer, Split Lock, #6, Brass	
812153	Washer, Split Lock, #8, Brass	
812154	Washer, Flat, #6, Brass	
822935	Mounting Plate	
822936	Mounting Angle	
822937	Mounting Bracket	

TABLE 6-16. Parts List, Main Chassis Assembly, 992312.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
080012	Tubing, Teflon, Clear, 12 AWG	
090003	Wire, Flat Braid, 18 AWG, 1/8 Wide	
312267	Transformer, Toroid	T1
410003	Diode, Silicon, 1N4148	CR7
440048	Transistor, 2N6109	Q1
730015	Relay, DPDT	K1
810513	Screw, BH, 4-40 x ¼	
810607	Screw, BH, 6-32 x ½	
810704	Screw, PH, 6-32 x ½, Swage Form	
810711	Screw, PH, 6-32 x 7/8, Brass	
811603	Nut, Hex, 6-32 x ¼	
812135	Washer, Flat #4	
812136	Washer, Flat #6	
812138	Washer, Split Lock, #6	
812143	Washer, Split Lock, #4	
812152	Washer, Split Lock, #6, Brass	
812154	Washer, Flat, #6, Brass	
812155	Screw Insulator, #6, Nylon	

TABLE 6-16. Parts List Main Chassis Assembly, 992312, continued.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
815009	Grommet, Rubber, 5/16 x [illegible] x 1/8	
816101	Lug, Internal Lock, #6	
816305	Post, Feedthru, Teflon, White	
816424	Terminal Lug, Crimp, #6 Stud	
821853	Insulator, Transformer	
822950	End, PC Housing	
822966	Bracket, Chassis Support	
823857	Side Plate, PC Housing	
823857-1	Side Plate with Insert	
824840	Base Plate	
992313	Wiring Harness Assembly	A10W1

TABLE 6-17. Parts List, Wiring Harness Assembly, 992313.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
010621 Thru 010669	Wire, 22 AWG per MIL-W-16878, Type B, Assorted Colors	
600018	Connector, Card Edge	
813011	Tie, Cable	
815009	Grommet, Rubber, 5/16 x ½ x 1/8	
816106	Lug, Locking Terminal, #4	
816122	Lug, Internal Locking	
816126	Lug, Flat, #2	

TABLE 6-18. Parts List, Fixed Inductor Assembly, 992321.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
010014	Bobbin, Inductor	
331342	Coil, Fixed Inductor	
810698	Screw, BH, 6-32 x 3/8, Brass	
810829	Screw, PH, 8-32 x 1½, Brass	
811609	Nut, Hex, 6-32 x 5/16, Brass	
811805	Nut, Hex, 8-32 x 5/16, Brass	
812055	Washer, Flat, #6, Brass	

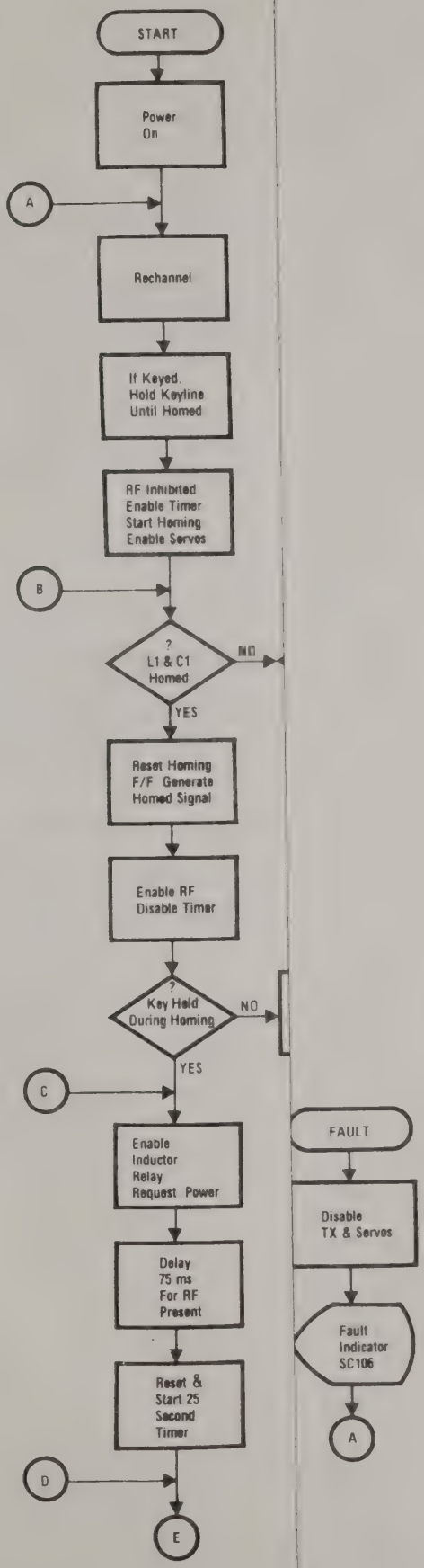
TABLE 6-18. Parts List, Fixed Inductor Assembly 992321, continued.

PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
812130	Washer, Flat, #8, Brass	
812147	Washer, Nylon, .188 x 1 x .06	
812152	Washer, Split Lock, #6, Brass	
812153	Washer, Split Lock, #8, Brass	
822957	Bracket, Fixed Inductor	

TABLE 6-19. Parts List, Accessory Kit, 992309.

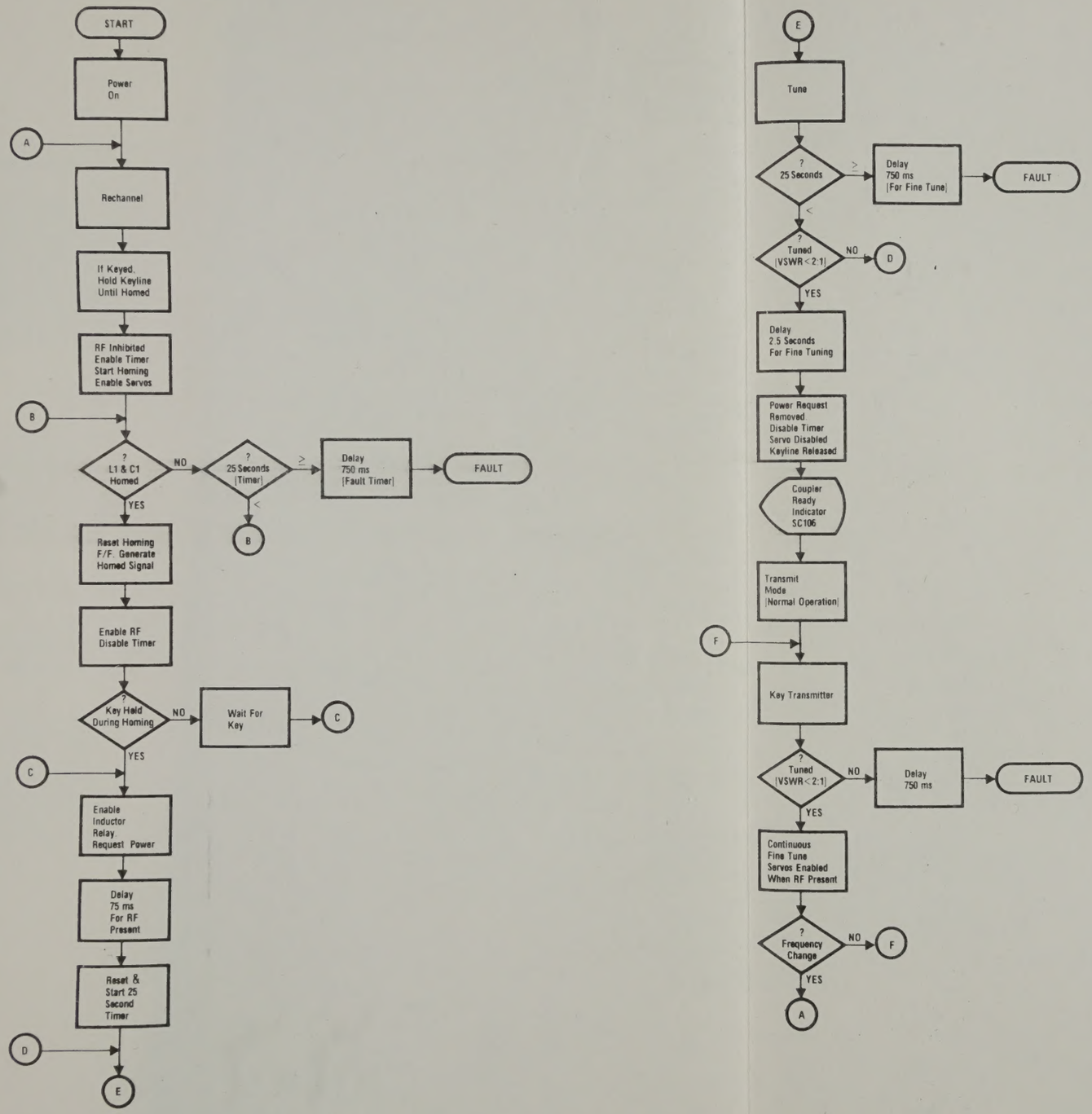
PART NUMBER	DESCRIPTION	REFERENCE DESIGNATION
010622	Wire, 22 AWG, Black	
050010	Tape, Electrical	
070024-1	Silicon Rubber Compound	
070035-1	Silicon Grease	
080019	Sleeving, Shrink, ½" Black	
080021	Sleeving, Shrink, 3/16" Black	
600022	Bushing	
610059	Connector, "N", Plug, UG-21C	
610061	Connector, Socket, 27 Pin	
800003	Allen Wrench, 1/16"	
810922-1	Bolt, Hex, ¼ - 20 x 1, Black	
811902-1	Nut, Hex, ¼-20 x 7/16, Black	
811918-1	Jam Nut, 5/16 - 18, Brass, Black	
812149-1	Washer, Flat, #¼, Black	
812159-1	Washer, Split Lock, #¼, Black	
812167	Washer, Internal/External Tooth, #¼	
812171	Washer, Split Lock, 5/16, Brass	
812172-1	Washer, Flat, 5/16, Brass, Black	
816146	Ground Lug	
827204-1	Control Cable Assembly Instruction	
827204-2	Coax Cable Assembly Instructions	
827204-4	Control Cable Assembly Instructions — Right Angle Connector	
827204-6	Coax Cable Assembly Instructions — Right Angle Connector	
991714	Ground Strap Assembly	
992308	Long Wire Adaptor	
992317	Manual, Operation and Maintenance	

APPENDIX

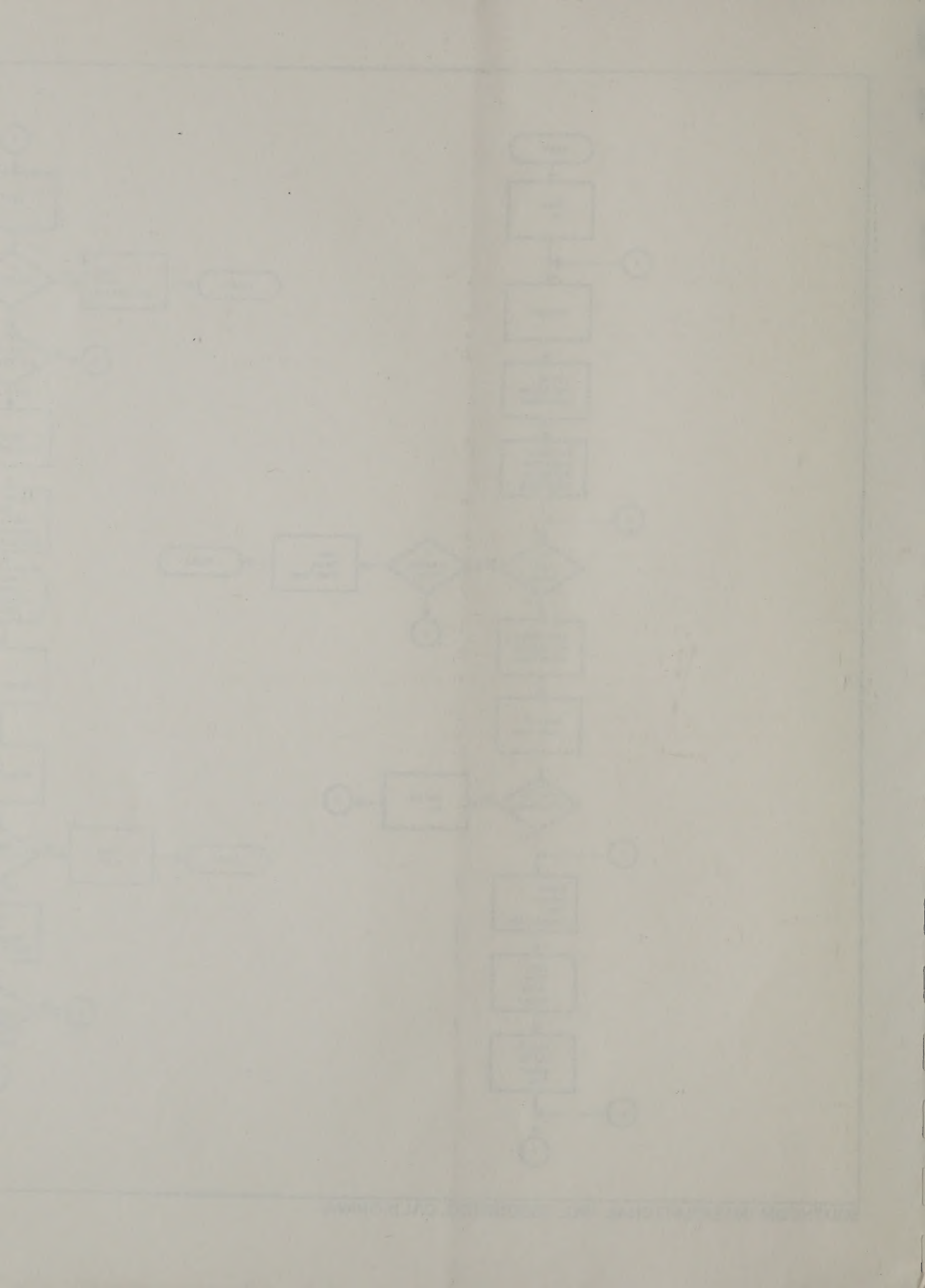


SC400 FLOW CHART

APPENDIX



SC400 FLOW CHART



PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT FOR REPAIR OR REPLACEMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a Return Authorization must be obtained from Southcom prior to shipment. The request for return authorization should include the following information:

1. Model number of equipment.
2. Serial number of equipment.
3. Southcom part number.
4. Nature of defect or cause of failure.
5. Contract or purchase order under which equipment was purchased.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity required.
2. Southcom part number.
3. Equipment in which used, by Southcom or military model number.
4. Brief description of the item.
5. The crystal frequency if order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

Southcom's warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with Southcom.

All correspondence pertaining to warranty claims, return, repair, or replacement and all materials or equipment returned for repair or replacement, within warranty or otherwise, should be addressed as follows:

SOUTHCOM INTERNATIONAL, INC.
Marketing Department
P.O. Box 2336
Escondido, California
92025
USA